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(54) **Transverse spinal rod connector clip**

Querverbindungsklemme für Wirbelsäulestäbe

Pince de liaison transversale pour tiges vertébrales

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(56) References cited:
**EP-A- 0 536 066**
**EP-A- 0 553 042**
**EP-A- 0 565 149**
**EP-A- 0 590 745**
**EP-A- 0 811 357**
**GB-A- 2 051 581**
**US-A- 5 380 326**
**US-A- 5 439 463**
**US-A- 5 507 746**



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## Description

### 1. Field of the Invention

**[0001]** The present invention relates to implantable spinal fixation systems for the surgical treatment of spinal disorders. More particularly, this invention relates to a transverse rod connector clip for connecting elongated spinal rods to each other.

### 2. Background of the Invention

**[0002]** For years doctors attempted to restore stability to the spine by fusion (arthrodesis) of the problem area. This treatment yielded marginal results due to the inherently flexible spinal column. Over the past ten years spinal implant systems have been developed to add stability to the spine to enhance the arthrodeds rates. Such systems often include spinal instrumentation having connective structures such as a pair of plates and/or rods which are placed on opposite sides of the portion of the spinal column which is intended to be fused. These spinal systems consist of screws and hooks for segmental attachment to the spine and longitudinal rods connected to screws or hooks. These components provide the necessary stability both in tension and compression yet yield minimal torsional control.

**[0003]** It has been found that when a pair of spinal rods are fastened in parallel on either side of the spinous process, the assembly can be significantly strengthened by using at least one additional rod to horizontally bridge the pair of spinal rods. A cross brace assembly is disclosed in US. Pat. No. 5,084,049. Devices such as these commonly consist of a threaded rod for providing the desired lateral support. The threaded rod is fastened to each of the spinal rods by clamps located on each end of the threaded rod. However, this configuration is bulky and can cause irritation of the patient's back muscles and other tissue which might rub against the device. A cross brace assembly that fits closer to the spine, preferably in the same general plane as the vertical spinal rods, would reduce the complications associated with bulkier devices.

**[0004]** Most existing transverse connectors consist of rods, plates, and bars linked to the longitudinal rods by coupling mechanisms with set screws, nuts, or a combination of each. These connectors require several components and instruments to build the constructs. Each additional Ornponent or instrument required to assemble the connectors adds to the "fiddle factor" of the surgical technique. Examples of these transverse connectors include Tranverse Link Device (DLT) and Crosslink manufactured by Sofamor Danek, Trans-Connector manufactured by Synthes, and Modular Cross Connector and Transverse Rod Connector (TRC) manufactured by AcroMed.

**[0005]** Telescopic rod to rod couplers for use in a spinal implant systems have also been described. Prior to the locking member being engaged, the telescoping sections may be easily slid past their extremes and out of engagement with one another. While this is a convenient method of connecting and disconnecting the coupler sections, it can be inconvenient during surgery if the sections accidentally disengage. U.S. Patent No. 5,275,600 describes a telescopic rod to rod coupler in which the telescopic rod sections are assembled together using a 180 degree twisting motion. This is designed to minimize the risk of the rod sections accidentally disconnecting during the implant procedure.

**[0006]** Presently available spinal fixation systems frequently require careful alignment of the hardware used to connect the components of the spinal instrumentation with each other. A need has thus arisen for improved rod connectors to transversely connect spinal rods without requiring additional manipulation of the spinal instrumentation and to minimize the use of pedicle screws while at the same time reducing requirements to assemble small pieces of hardware during the surgical procedure.

**[0007]** Further, there are different rod connectors in the state of the art, like the holding and fixing mechanism disclosed in US 5,507,746 or the perpendicular rod connector disclosed in EP 0 565 149 A2. In addition, US 5,380,326 discloses a clamping device for a vertebral locking rod according to the preambular of claim 1.

### SUMMARY OF THE INVENTION

**[0008]** The present invention is directed to transverse connector clips for connecting elongated spinal rods in spinal fixation systems and provides a connector for connecting two elongated spinal rods to one another according to claim 1. Preferred embodiments of the invention are defined in the dependent claims.

**[0009]** The transverse connectors of the present invention can be used to transversely connect spinal rods without requiring additional manipulation of the spinal instrumentation. Because the connectors of the present invention do not require any additional locking mechanism, they reduce the assembly of small pieces of hardware during the surgical procedure.

### BRIEF DESCRIPTION OF THE DRAWINGS

**[0010]**

Figure 1 is a perspective view of an embodiment of the present invention illustrating the method of assembly; and

Figure 2 is a perspective view of the assembled embodiment of the invention of Fig. 1.

## DETAILED DESCRIPTION OF A PREFERRED EMBODIMENT

**[0011]** The present invention is directed to a transverse connector clip 10E and assemblies used in spinal fixation systems. Spinal fixation systems typically include spinal instrumentation having connective structures such as a pair of plates and/or rods which are placed on opposite sides of the spinal column near vertebrae that are intended to be fused. These spinal systems consist of screws and hooks for segmental attachment to the spine and longitudinal rods connected to screws or hooks. These components provide the necessary stability both in tension and compression yet yield minimal torsional control. In addition, it has been found that when a pair of spinal rods are fastened in parallel on either side of the spinous process, the assembly can be significantly strengthened by using at least one additional rod to horizontally bridge the pair of spinal rods.

**[0012]** The transverse connector clips 10E of the present invention consist of a component with a means to dip the device on a spinal or cylindrical rod 11 and a component with a means to link two rod connectors together laterally. Transverse connector clip 10E concept consists of a clip body 12 with a first portion and a second portion (Figure 1). On first portion are two, mirror image hemi-cylindrical shells 18 and 20. These two, mirror image hemi-cylindrical shells 18 and 20 have an inner surface that defines a rod bore through which the cylindrical rod 11 can extend. Rod bore has an inner diameter that is designed to be slightly smaller than the outer diameter of the cylindrical rod 11 it will receive. Top surface of the hemi-cylindrical shells 18 and 20 defines an outer diameter.

**[0013]** It should be noted that the two, mirror image hemi-cylindrical shells 18 and 20 can be connected to the first portion of clip body 12 as shown in clip 10E of Figure 1 or in mirror image relationship.

**[0014]** Clip body 12 is placed on the cylindrical rod 11 at 90 degrees and turned so that the hemi-cylindrical shells 18 and 20 spread around the rod 11. The deflection of the hemi-cylindrical shells 18 and 20 and the inner diameter of the shells 22 allow the clip 10 to securely clamp on the rod 11.

**[0015]** The second side of the clip body 12 includes an outwardly extending U-shaped receptacle designed to receive a semi-cylindrical or cylindrical rod and a locking cap device (Clip 10E, Figures 1-2).

**[0016]** In an embodiment of the inventive transverse connector (clip) 10E, the first portion of the clip body 12 is as previously described, while the second portion of the clip body 12 comprises an outwardly extending rod holding portion 120 and a locking mechanism 130. The rod holding portion has a longitudinal axis positioned perpendicular to the longitudinal axis LA1-LA1 of the first portion of the clip body 12. The locking mechanism 130 is configured to engage with the rod holding portion 120 in order to locking the longitudinal rod into the rod holding portion 120. The rod holding portion is in the shape of a solid holding portion having a through bore for receiving a hemi-cylindrical or cylindrical rod and the locking mechanism can be of any locking mechanism known to one skilled in the art, such as tapered locking caps, set screws or locking nuts. In one embodiment, the holding portion is a U-shaped holding portion 120 having a longitudinal axis LA3-LA3 positioned perpendicular to the longitudinal axis LA1-LA1 of the first portion of connector clip 10E (Figures 1-2). The U-shaped holding portion 120 has an upper portion 122 and a lower portion 124. The lower portion 124 is configured to receive a flat side 126 of a hemi-cylindrical and 128. A locking mechanism for the U-shaped portion 120 can include a locking cap 130 with an upper 132 and lower side 134 configured to slide into and mate with the upper portion 122 of U -shaped portion 120. Upper side 132 of locking cap 130 has a tapered portion 136 that engages and mates with a tapered portion 138 of the upper portion 122 of the U-shaped portion 120. Further, the top portion 132 of the locking member 130 includes a pair of opposed supplemental retention members spaced from the opposed tapered retention members 136. The lower side 134 of the locking cap 130 is configured to accommodate at an arcuate side 140 of the hemi-cylindrical rod 128.

**[0017]** The advantage of the inventive clip 10E, when used in combination with the locking cap 130, the hemi-cylinder support bar 128, and cylindrical rod 11 (Figure 1-2) is that connecting clip 10E is a single piece that connects two rods together, thus reducing the requirement of the prior art connectors to assemble small pieces of hardware during the surgical procedure.

**[0018]** It should be understood that in keeping with spinal surgery techniques, a plurality of cylindrical rods 11 can be used, each with a plurality of attachment devices affixed thereto, with the present attachment devices transversely connecting either two rods 11 together or connecting portions of rods together in other alignments.

**[0019]** The foregoing disclosure and description of the invention are illustrative and explanatory thereof, and various changes in the details of the illustrated apparatus and construction and method of operation may be made without departing from the scope of the invention, as defined in the claims

## Claims

1. A connector (10 E) for connecting two elongated spinal rods (11, 128) to one another in a spinal fixation system comprising:

   a clip body (12) including a first portion and a second portion, the first portion of the clip body configured to receive and engage a first elon-

gated spinal rod (11), the second portion of the clip body having a transverse bore (120) therein for receiving a second elongated spinal rod (128) extending transverse to the first elongated spinal rod; and
a locking member (130) dimensioned and configured for mounting in the transverse bore in the second portion of the clip body so as to fix the position of the second elongated spinal rod with respect to the first elongated spinal rod, wherein the locking member (130) comprises a top portion (132) having a tapered portion (136) that engages and mates under a tapered portion (138) in an upper portion (122) of the u-shaped portion (120), **characterized in that** the U-shaped transverse bore has a pair of spaced apart side walls and a substantially planar lower portion extending between the side walls.

2. A connector as recited in Claim 1, wherein the first portion of the clip body includes a pair of opposed spaced apart arcuate rod engaging hooks (18, 20) for receiving and engaging the first elongated spinal rod (11).

3. A connector as recited in any of the preceding claims, wherein each arcuate rod engaging hook (18, 20) defines a curve having a common central axis.

4. A connector as recited in any of the preceding claims, wherein the second elongated spinal rod (128) has a generally semi-circular transverse cross-section for reception by the lower portion (124) of the U-shaped opening.

5. A spinal fixation system comprising:

a first elongated spinal rod (11) having a first transverse cross-section;
a second elongated spinal rod having a second transverse cross-section different than the transverse cross-section of the first elongated spinal rod; and
a connector according to claim 2.

6. A spinal fixation system as recited in 5, wherein the first elongated spinal rod (11) has a circular transverse cross-section and wherein the second elongated spinal rod (128) has a generally semi-circular transverse cross-section.

7. A spinal fixation system as recited in any of the preceding claims, wherein the second elongated spinal rod (128) includes a planar surface for contacting the substantially planar lower portion (124) of the second portion (120) of the connector (10 E).

8. A spinal fixation system as recited in any of the preceding claims, wherein each side wall has a tapered engagement slot (138) formed therein, and the locking member (130) includes a top portion (132) and a bottom portion (134), the top portion having a pair of opposed tapered retention members (136) each for engaging a respective one of the tapered engagement slots in the side walls, and a hemi-cylindrical groove in a bottom surface (134) thereof for accommodating a portion of the second elongated spinal rod.

9. A spinal fixation system as recited in any of the preceding claims, wherein the top portion (132) of the locking member (130) includes a pair of opposed supplemental retention members spaced from the opposed tapered retention members (136) on the top portion.

**Patentansprüche**

1. Verbinder (10E) zum miteinander Verbinden zweier länglicher Spinalstangen (11, 128) in einem spinalen Befestigungssystem, umfassend:

einen Clipkörper (12), der einen ersten Abschnitt und einen zweiten Abschnitt einschließt, wobei der erste Abschnitt des Clipkörpers derart gebildet ist, um die erste längliche Spinalstange (11) aufzunehmen und zu greifen, wobei der zweite Abschnitt des Clipkörpers eine Querbohrung (120) darin zum Aufnehmen einer zweiten länglichen Spinalstange (128) besitzt, die sich quer zu der ersten länglichen Spinalstange erstreckt; und

ein Verriegelungselement (130), das zum Montieren in der Querbohrung in dem zweiten Abschnitt des Clipkörpers derart dimensioniert und gebildet ist, um die Position der zweiten länglichen Spinalstange in Bezug auf die erste längliche Spinalstange festzusetzen, worin das Verriegelungselement (130) einen oberen Abschnitt (132) aufweist, der einen verjüngten Abschnitt (136) besitzt, welcher unter einen verjüngten Abschnitt (138) in einem oberen Abschnitt (122) des U-förmigen Abschnitts (120) eingreift und passt, **dadurch gekennzeichnet, dass**

die U-förmige Querbohrung ein Paar beabstandeter Seitenwände und einen im wesentlichen ebenen unteren Abschnitt, der sich zwischen den Seitenwänden erstreckt, besitzt.

2. Verbinder nach Anspruch 1, worin der erste Abschnitt des Clipkörpers ein Paar gegenüberliegen-

der, beabstandeter, bogenförmiger Stangengreifhaken (18, 20) zum Aufnehmen und Greifen der ersten länglichen Spinalstange (11) aufweist.

3. Verbinder nach einem der vorhergehenden Ansprüche, worin jeder bogenförmige Stangengreifhaken (18, 20) eine Kurve definiert, die eine gemeinsame zentrale Achse besitzen.

4. Verbinder nach einem der vorhergehenden Ansprüche, worin die zweite längliche Spinalstange (128) einen allgemein halbkreisförmigen Querschnitt zur Aufnahme durch den unteren Abschnitt (124) der U-förmigen Öffnung besitzt.

5. Spinales Befestigungssystem, umfassend:

eine erste längliche Spinalstange (11), die einen ersten Querschnitt besitzt;

eine zweite längliche Spinalstange, die einen zweiten Querschnitt besitzt, der von dem Querschnitt der ersten länglichen Spinalstange unterschiedlich ist; und

einen Verbinder nach Anspruch 2.

6. Spinales Befestigungssystem nach Anspruch 5, worin die erste längliche Spinalstange (11) einen kreisförmigen Querschnitt besitzt, und worin die zweite längliche Spinalstange (128) einen allgemein halbkreisförmigen Querschnitt besitzt.

7. Spinales Befestigungssystem nach einem der vorhergehenden Ansprüche, worin die zweite längliche Spinalstange (128) eine ebene Fläche zu berühren des im wesentlichen ebenen unteren Abschnitts (124) des zweiten Abschnitts (120) des Verbinders (10E) aufweist.

8. Spinales Befestigungssystem nach einem der vorhergehenden Ansprüche, worin jede Seitenwand einen verjüngten Eingriffsschlitz (138) darin gebildet besitzt, und das Verriegelungselement (130) umfasst einen oberen Abschnitt (132) und einen unteren Abschnitt (134), wobei der obere Abschnitt ein Paar gegenüberliegender, verjüngter Halteelemente (136) jeweils zum Eingreifen in einen entsprechenden der verjüngten Eingriffsschlitze in den Seitenwänden besitzt, und eine halbzylindrische Nut in einer Bodenfläche (134) davon zum Aufnehmen eines Abschnitts der zweiten länglichen Spinalstange.

9. Spinales Befestigungssystem nach einem der vorhergehenden Ansprüche, worin der obere Abschnitt (132) des Verriegelungselements (130) ein Paar gegenüberliegender, zusätzlicher Halteelemente aufweist, die von dem gegenüberliegenden, verjüngten Halteelementen (136) an dem oberen Abschnitt beabstandet sind.

## Revendications

1. Elément de liaison (10 E) pour relier deux tiges vertébrales oblongues (11, 128) l'une à l'autre dans un système de fixation vertébrale, comprenant :

un corps de pince (12) comportant une première portion et une seconde portion, la première portion du corps de pince étant configurée pour recevoir et venir en prise avec une première tige vertébrale oblongue (11), la seconde portion du corps de pince ayant un perçage transversal (120) dans celle-ci pour recevoir une seconde tige vertébrale oblongue (128) s'étendant transversalement à la première tige vertébrale oblongue ; et
un élément de verrouillage (130) dimensionné et configuré pour l'installation dans le perçage transversal dans la seconde portion du corps de pince de manière à fixer la position de la seconde tige vertébrale oblongue par rapport à la première tige vertébrale oblongue, où l'élément de verrouillage (130) comporte une portion supérieure (132) présentant une portion diminuée (136) qui s'engage dans et s'adapte sous une portion diminuée (138) dans une portion supérieure (122) de la portion en forme de u (120), **caractérisé en ce que**
le perçage transversal en forme de U présente deux parois latérales espacées et une portion inférieure sensiblement plane s'étendant entre les parois latérales.

2. Elément de liaison selon la revendication 1, où la première portion du corps de pince comporte deux crochets opposés, espacés, arqués (18, 20) de mise en prise avec la tige pour recevoir et venir en prise avec la première tige vertébrale oblongue (11).

3. Elément de liaison selon l'une des revendications précédentes, où chaque crochet arqué (18, 20) de mise en prise avec la tige définit une courbe ayant un axe central commun.

4. Elément de liaison selon l'une des revendications précédentes, où la seconde tige vertébrale oblongue (128) a une section transversale généralement semi-circulaire pour la réception par la portion inférieure (124) de l'ouverture en forme de U.

5. Système de fixation vertébrale comprenant :

une première tige vertébrale oblongue (11) ayant une première section transversale ;
une seconde tige vertébrale oblongue ayant une seconde section transversale différente de la section transversale de la première tige vertébrale oblongue ; et
un élément de liaison selon la revendication 2.

6. Système de fixation vertébrale selon la revendication 5, où la première tige vertébrale oblongue (11) a une section transversale circulaire et où la seconde tige vertébrale oblongue (128) a une section transversale généralement semi-circulaire.

7. Système de fixation vertébrale selon l'une des revendications précédentes, où la seconde tige vertébrale oblongue (128) comporte une surface plane pour venir en contact avec la portion inférieure sensiblement plane (124) de la seconde portion (120) de l'élément de liaison (10 E).

8. Système de fixation vertébrale selon l'une des revendications précédentes, où chaque paroi latérale comporte une fente d'engagement diminuée (138) formée dans celle-ci, et l'élément de verrouillage (130) comporte une portion supérieure (132) et une portion inférieure (134), la portion supérieure comportant deux éléments de retenue diminués opposés (136), chacun pour s'engager dans respectivement l'une des fentes d'engagement diminuées dans les parois latérales, et une rainure demi-cylindrique dans une surface inférieure (134) de celle-ci pour recevoir une portion de la seconde tige vertébrale oblongue.

9. Système de fixation vertébrale selon l'une des revendications précédentes, où la portion supérieure (132) de l'élément de verrouillage (130) comporte deux éléments de retenue supplémentaires opposés espacés des éléments de retenue diminués opposés (136) sur la portion supérieure.

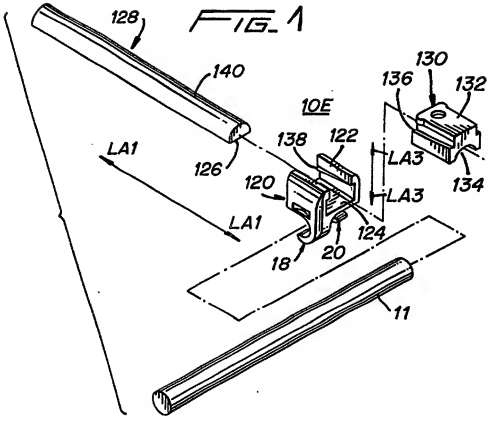
128
140
126
LA1
LA1
120
138
122
10E
130
136
132
LA3
LA3
134
124
18
20
11

FIG. 1

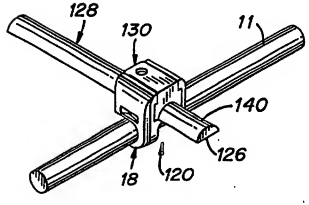
128
130
11
140
126
18
120

FIG. 2

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(54) **Clamping connnector for spinal fixation systems**

Klemmverbindung für Wirbelsäulenfixationssysteme

Rapport de serrage pour systèmes de fixation du rachis

(84) Designated Contracting States:
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(56) References cited:
**FR-A- 2 697 743**
**FR-A- 2 730 155**
**FR-A- 2 731 344**
**US-A- 5 380 326**
**US-A- 5 613 968**



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## Description

### BACKGROUND OF THE INVENTION

1. Field of the Invention

**[0001]** The present invention relates to spinal fixation systems for use in the treatment of spinal deformities and more particularly to a clamping connector for attaching angularly misaligned pedicle screws to transverse spinal rods in spinal fixation systems.

2. Description of the Prior Art

**[0002]** Surgeons treat spinal disorders with spinal fusion augmented with longitudinal spinal rods connected to the spine with lamina hooks or pedicle screws. Such "rod assemblies" generally comprise one or two spinal rods and a plurality of screws inserted through the pedicles and into their respective vertebral bodies. The screws are provided with coupling elements, for coupling the elongate rod to the screws. The rods extends along the longitudinal axis of the spine, coupling to the plurality of screws via their coupling elements. The aligning influence of the rod forces the spine to which it is affixed, to conform to a more proper shape.

**[0003]** Due to anatomical variations, pedicle screws may not properly align with the longitudinal spinal rods. In order to eliminate the need for lateral rod bending, a device is required to connect the rod to the screws in such a way as to compensate for lateral deviation of the spinal rods.

**[0004]** The art contains a variety of attempts at providing instrumentation that permits a range freedom with respect to angulation of the screw and the coupling element. These teachings, however, have generally been complex, and unreliable with respect to durability. The considerable drawbacks associated with the prig art systems include complexity, difficulty properly positioning the rod and the coupling elements, and the tedious manipulation of many small parts associated with the complex spinal fixation devices.

**[0005]** Various connector designs exists to accommodate screws offset from the rod, these include the Smith & Nephew Rogozinski (U.S. patent 5,102,412), the Sofmor, S.N.C. (u.s patent 5,591,165) showing the features of the preamble of claim 1 and Finn Systems (U.S. patent 5,474,551), the Synthes Universal System, and the

**[0006]** Zimmer Modulok System (now the Wrightlok System from Wright Medical).

**[0007]** Each of these systems require two locking mechanisms for the connector -- one to link the pedicle screw to the connector and another to link the connector to the rod. Some of these devices provide variable lateral adjustment while other provide only a fixed distance of offset. The Sofmor Danek TSRH System (U.S. patent 5,282,801) provides a means to offset a screw from the rod with a single set screw yet the lateral distances are fixed. French patent FR-A-2,730,155 does describe a system with only one locking system. However, this locking system employs many small parts including a nut which has to be tightened.

**[0008]** Other types of screws, hooks and clamps have been used for attaching corrective spinal instrumentation to selected portions of the patient's spine. Examples of pedicle screws and other types of attachments are shown in U.S. patent Nos., 5,613,968, 5,562,662, 5,498,262, 5,380,326, 5,312,404, 5,209,752 and 5,002,542. However, many current bolt to rod connectors constrain the bolt or screw to a predetermined angle in relation to the connector when the assembly is tightened.

**[0009]** Tightening the bolt or screw to the connector forces the bolt or screw into a position perpendicular to the connector, creating stresses on the connector and on the bone as the bolt or screw is forced into the perpendicular position.

**[0010]** When spinal rod system are implanted in the sacral region of the spine, the bone screws need to allow for the variability in angulation found between the sacral and lumbar vertebrae. The bone screws also need to be able to pivot in the medial/lateral plane as well as have the ability to pivot and lock in the cephalad/caudal plane while maintaining the proper alignment between an implanted bone screw, a coupler and a rod of a spinal fixation system.

**[0011]** Accordingly, it is a principal object of the present invention to provide a spinal rod linkage apparatus for connecting two or more vertebral bodies in a lateral direction whereby healing of a bone graft between the vertebral bodies is enhanced.

**[0012]** It is another object of the present invention to provide a connector that compensates for angular misalignment, in the transverse plane between both the implanted bolt or screw and the spinal rod, and the bolt or screw and the connector in order to reduce stress on the bolt or screw when it is firmly fastened to the connector.

**[0013]** It is a further object of the present invention to provide a connector that allows for attachment to both the spinal rod and the implanted bone screw with only one locking mechanism.

**[0014]** It is another object of the present invention to provide a connector that provides for variable lateral distances between the spinal rod and the implanted pedicle screw.

### SUMMARY OF THE INVENTION

**[0015]** The present invention is directed to a one piece connector for connecting angularly misaligned implanted pedicle screws to longitudinal spinal rods in spinal fixation systems. The one piece connector has a body portion and a leg portion that intersects the body portion at a 90° angle. The body portion includes a bore having an inside diameter and a longitudinal axis, with the lon-

gitudinal axis of the bore being positioned perpendicular to the longitudinal axis of the leg portion. The leg portion includes a slot placed through a section of the leg portion, the slot being placed along the transverse axis of the leg portion and parallel to the longitudinal axis of the leg portion. The slot intersects the bore of the body portion perpendicular to the longitudinal axis of the bore. The slot allows the one piece connector to be securely damped around a longitudinal spinal rod when a pedicle screw is implanted at variable distances from the longitudinal spinal rod. The one piece connector allows for angular misalignment of an implanted pedicle screw in relation to a longitudinal spinal rod and the one piece connector, and for the attachment of the one piece connector to both the longitudinal spinal rod and to the implanted pedicle screw with a single locking mechanism when the one piece connector is used in a spinal fixation system.

## BRIEF DESCRIPTION OF THE DRAWINGS

**[0016]** A better understanding of the invention can be obtained when the detailed description of exemplary embodiments set forth below is reviewed in conjunction with the accompanying drawings, in which:

FIGURE 1 is a schematic view of a human spine with an implanted spinal fixation system using the connectors of the present invention;
FIGURE 2 is a perspective view of a section of a spinal fixation system illustrating the connector of the present invention attaching a pedicle screw to a spinal rod;
FIGURE 3 is a top plane view of the assembly of Fig. 2;
FIGURE 4 is a perspective view of one embodiment of the present invention;
FIGURE 5 is a perspective view of another embodiment of the present invention;
FIGURE 6A is a cross-sectional view of the present invention of Fig. 4 taken along lines 6-6 showing the inner surface of the bore;
FIGURE 6B is a cross-sectional view of the subject invention of Fig. 4 taken along lines 6-6 showing the bore tapering in a first direction;
FIGURE 6C is a cross-sectional view of the present invention of Fig. 4 taken along lines 6-6 showing the inside surface of the bore tapering in a second direction;
FIGURE 7 is a perspective view of the first end of the invention of Fig. 4;
FIGURE 8 is a perspective of an alternative embodiment of the present invention;
FIGURE 9 is a perspective view of a second alternative embodiment of the present invention;
FIGURE 10 is a perspective view of a portion of the pedicle screw of Fig. 2 showing a locking mechanism for connecting the present invention to the implanted pedicle screw;
FIGURE 11 is a plane view of the present invention of Fig. 2 illustrating a first range of rotation; and
FIGURE 12 is a side plane view of the present invention of Fig. 2 illustrating a second range of rotation.

## DETAILED DESCRIPTION OF INVENTION

**[0017]** The present invention is directed to a one piece connector 10 that is used in spinal fixation systems such as the one shown in Fig. 1. Spinal fixation systems typically include spinal rods 12 and pedicle screws 42 or bone bolts (not shown). The one piece connector 10 includes a body portion 14 and a leg portion 16 (Figs. 4 and 7). Body portion 14, in a preferred embodiment is generally cylindrical in shape with a longitudinal through bore 18 that has a longitudinal axis LA1-LA1, as shown in Fig. 5. However, body portion 14 can also have other shapes, such as for example, a spherical, oval or cubic shape. Bore 18 has a first end 20 and a second end 22 and an inside diameter D1-D1 (Fig. 6A) that in one embodiment is a constant dimension along the longitudinal axis LA1-LA1 from first end 20 to second end 22. Alternatively bore 18 can taper from a smaller inside diameter at first end 20 to a larger inside diameter D2-D2 at end 22 as shown in Fig. 6B or conversely bore 18 can taper from a larger diameter at end 20 to a smaller inside diameter D3-D3 at second end 22 as illustrated in Fig. 6C. However, in all embodiments, the inside diameter of bore 18 will be greater than an outside diameter of an appropriately sized spinal rod that is part of a spinal fixation system.

**[0018]** Leg portion 16 is generally a solid cylinder with a first end 24 and a second end 26 with the second end 26 intersecting the body portion 14 at a 90° angle (Fig. 7). Leg portion's 16 outer surface can be either smooth or textured. Leg portion 16 has a longitudinal axis LA2-LA2 (Fig. 5) and a transverse axis TA-TA (Fig. 7). Thus, longitudinal axis LA1-LA1 of bore 18 is positioned perpendicular to the longitudinal axis LA2-LA2 of leg portion 16. Leg portion 16 is split in two portions with a narrow slot 28, that is positioned along a transverse axis TA-TA and runs parallel to the longitudinal axis LA2-LA2 of leg portion 16 (Figs. 4 and 7). Slot 28 includes a first end 30 and a second end 32 with first end 30 intersecting bore 18 of body portion 14 perpendicular to the longitudinal axis LA1-LA1 of bore 18, at the second end 26 of leg portion 16. Slot 28 has a constant width from first end 30 to second end 32 with the width being greater than the difference between the inside diameter of bore 18 and an outside diameter of a selected spinal rod 12. The width of slot 28 creates a clamping force on spinal rod 12 when the one piece connector 10 is placed over spinal rod 12 and connected to an implanted pedicle screw 42. Alternatively, the width of slot 28 can taper from a smaller width at first end 30 to a larger width at second end 32 or conversely from a larger width at first

end 30 to a smaller width at second end 32. This tapering of the width of slot 28 increases the clamping force of the one piece connector 10 on spinal rod 12 when pedicle screw 42 is connected to the one piece connector 10 at variable points along the longitudinal axis LA2-LA2 of the leg portion 16. In one embodiment, second end 32 of slot 28 of the one piece connector 10 extends to and creates an opening in the first end 24 of leg portion 16 (Figs. 4 and 7). In a second embodiment, as shown in Fig. 5, second end 32 of slot 28 stops short of the first end 24 of leg portion 16 so as to create a solid portion at the first end 24 of leg portion 16.

**[0019]** Alternatively, leg portion 16 of the one piece connector can taper from a larger outside diameter at second end 26 to a smaller outside diameter at first end 24 (Fig. 8) or conversely from a larger outside diameter at first end 24 to a smaller outside diameter at second end 26 of leg portion 16 (Fig. 9). The tapering of leg portion 16 also increases the clamping force of the one piece connector 10 on the longitudinal spinal rod 12 when pedicle screw 42 is connected to the one piece connector 10 at variable points along the longitudinal axis LA2-LA2 of the leg portion 16.

**[0020]** As an example only, one size of the one piece connector 10 can have a leg portion 16 with a length of approximately 12.4 mm (0.49 inches) and a diameter of approximately 5.1 mm (0.2 inches), and a body portion 14 with an outside diameter of approximately 7.6 mm (0.3 inches) and a bore 18 with a diameter of approximately 5.1 mm (0.2 inches).

**[0021]** The inside diameter of bore 18 of body portion 14 allows the one piece connector 10 to slide along the longitudinal spinal rod (line L-L in Fig. 3) in order to correctly position the one piece connector in relation to the implanted pedicle screw 42. The inside diameter of bore 18 of body portion 14 also allows for a 360° rotation of the one piece connector 10 around the spinal rod 12 (line T1-T1 in Fig. 11). This rotation allows for any transverse angular misalignment between the implanted pedicle screw 42 and the spinal rod 12 when the one piece connector is secured in place. The ability of the one piece connector to compensate for this angular misalignment reduces stress on the pedicle screw 42 and reduces lateral bending of the spinal rod 12 when the pedicle screw 42 is firmly fastened to the one piece connector 10 and the connector 10 is firmly clamped to spinal rod 12. Additionally, when the one piece connector 10 is attached to the pedicle screw 42, the generally circular shape of leg portion 16 allows the pedicle screw 42 to rotate 360° around leg portion 16 prior to being mechanically locked to the one piece connector 10 (line T2-T2 in Fig. 12). This rotation allows for any transverse angular misalignment between the one piece connector 10 and the implanted pedicle screw 42 when the one piece connector is secured in place. The ability of the one piece connector 10 to compensate for this angular misalignment also reduces stress on the pedicle screw 42 and reduces lateral bending of the spinal rod 12 when the pedicle screw 42 is firmly fastened to the one piece connector 10 and the connector 10 is firmly clamped to spinal rod 12.

**[0022]** The one piece connector 10 also allows the pedicle screw 42 to be offset at variable lateral distances from the spinal rod 12, as shown by line V-V in Fig. 3. The pedicle screw 42 can be locked to the one piece connector 10 at various selected points between the first and second ends 24, 26 of leg portion 16 of the one piece connector 10.

**[0023]** An inventive feature of the one piece connector 10 is its ability to be locked in place on both the longitudinal spinal rod 12 and the implanted pedicle screw 42 with a single locking mechanism on the pedicle screw 42. When used in a spinal fixation system, body portion 14 clamps around spinal rod 12. Pedicle screw 42 typically includes a U-shaped opening, a through bore or some other opening shaped to accommodate the one piece connector 10. Pedicle screw 42 including some form of a locking mechanism for locking the one piece connector 10 or other cylindrical member into the pedicle screw 42. Typical locking mechanisms found on pedicle screws or bone bolts include various kinds of tops or caps that include set screws or taper locking caps or a locking nut for use with bone bolts. These various locking mechanisms are known to one skilled in the art.

**[0024]** An example of a pedicle screw that can be used with the one piece connector is illustrated in Figs. 2 and 10. Pedicle screw 42 has a shaft portion 44 and a top portion 46 that includes a U-shaped opening 48 configured to receive the one piece connector 10. A locking cap 50 is inserted into the U-shaped opening 48 in order to clamp the one piece connector 10 into the pedicle screw 42. When the one piece connectors 10 are used in a spinal fixation system, the spinal rod 12 is placed through bore 18 of the body portion 14 of each connector and the connectors 10 are positioned along the spinal rod 12 in proper alignment with the implanted pedicle screws 42. The one piece connector 10 is angularly adjusted in order to compensate for the pedicle screws 42 that are misaligned in relation to the spinal rod 12. Head 46 of the pedicle screw 42 is positioned so that the U-shaped opening 48 is perpendicular to the longitudinal spinal rod 12. Leg portion 16 of the one piece connector 10 is placed through the U-shaped opening 48 and locking cap 50 is inserted into the U-shaped opening 48 in order to clamp the one piece connector 10 into the pedicle screw 42. As locking cap 50 is locked into place, it compresses the leg portion 16, which causes slot 28 to be compressed which causes body portion 14 of the one piece connector 10 to clamp around the spinal rod 12.

**[0025]** The one piece connector 10, thus provides a secure link between the spinal rod 12 and the implanted pedicle screw 42 with a single connector and a single locking mechanism. The one piece connector 10 allows the pedicle screw 44 to be clamped to the one piece

connector at various angles and the one piece connector 10 to be damped to the spinal rod 12 at various angles.

**[0026]** The foregoing disclosure and description of the invention are illustrative and explanatory thereof, and various changes in the details of the illustrated apparatus and construction and method of operation may be made without departing from the scope of the invention.

## Claims

1. A spinal fixation system comprising

   - an elongated spinal rod (12);
   - a bone fastener (42) having a top portion (46) defining a transverse bore (48) and an elongated threaded shaft portion (44) depending from the top portion (46);
   - a connector (10) comprising
   - a body portion (14) having a transverse opening (18) to receive the elongated spinal rod (12), the opening (18) configured to facilitate rotation of the connector (10) about the longitudinal axis of said spinal rod (12) and longitudinal movement of the connector (10) along the longitudinal axis of said spinal rod (12); and
   - a leg portion (16) extending from the body portion (14) along an axis extending perpendicular to the opening (18), the leg portion (16)being dimensioned and configured to extend through the transverse bore (48) in the top portion (46) of the bone fastener (42) thus allowing the bone fastener (42) to be positioned at any desired location along and about the longitudinal axis of the leg portion (16); and
   - a locking member (50) configured to engage said transverse bore (48) in said bone fastener (42) and thus fix the position of said bone fastener (42) relative to the leg portion (16) of the connector (10)

   **characterized in that**
   said leg portion (16) is bifurcated along the longitudinal axis thereof, thus defining a transverse slot (28), and defining two compressible portions extending perpendicular to, and intersecting with, the opening (18) in said body portion(14), wherein said two compressible portions are compressed by said locking member (50) so that said connector (10) is clamped to said spinal rod (12) so that the position of the transverse opening (18) of the connector (10) relative to the spinal rod (12) is fixed.

2. A Spinal fixation system as recited in claim 1, wherein the shaft portion (44) includes bone threads.

3. A Spinal fixation system as recited in any of the preceding claims, wherein the transverse bore (48) is further defined by a lower portion having a hemi-cylindrical seat defined therein for accommodating a lower portion of the leg portion (16) of said connector (10).

4. A spinal fixation system as recited in any of the preceding claims, wherein the locking member (50) includes a hemi-cylindrical recess in a bottom surface thereof for accommodating an upper portion of the leg portion (16) of said connector (10).

5. A spinal fixation system as recited in any of the preceding claims, wherein the transverse slot (28) in the leg portion (16) has a second end adjacent a distal end of the leg portion (16).

6. A spinal fixation system as recited in any of claims 1 to 4, wherein the transverse slot (28) in the leg portion (16) has a second end extending through a distal end of the leg portion (16).

7. A spinal fixation system as recited in claim 3 or any of claims 4 to 6 dependent on claim 3, wherein the transverse bore (48) in the top portion of the bone fastener (42) is defined by a U-shaped opening having a pair of opposed side walls and a floor, each side wall having a tapered engagement slot formed therein.

8. A spinal fixation system as recited in claim 7, as dependent on claim 4, wherein the locking member (50) includes a top portion and a bottom portion, the bottom portion having a pair of opposed tapered retention members for engaging the tapered engagement slots in the opposed side walls of the U-shaped opening.

9. A spinal fixation system as recited in any of the preceding claims, wherein the top portion of the locking member (50) includes a pair of supplemental retention members spaced from the opposed tapered retention members.

## Patentansprüche

1. System zur Fixierung der Wirbelsäule mit

   - einer länglichen Wirbelsäulenstange (12);
   - einem Knochenbefestiger (42) mit einem oberen Bereich (46) mit einer Querbohrung (48) und mit einem länglichen Gewindeschaftbereich (44), der sich an den oberen Bereich (46) anschließt;

- einem Verbinder (10) mit

  -- einem Körperbereich (14) mit einer Queröffnung (18) zur Aufnahme der länglichen Wirbelsäulenstange (12), wobei die Öffnung (18) so gestaltet ist, dass sie die Drehung des Verbinders (10) um die Längsachse der Wirbelsäulenstange (12) herum und die Längsbewegung des Verbinders (10) entlang der Längsachse der Wirbelsäulenstange (12) erleichtert; und

  -- einem Beinbereich (16), der sich von dem Körperbereich (14) aus entlang einer Achse erstreckt, die senkrecht zu der Öffnung (18) verläuft, wobei der Beinbereich (16) so bemessen und ausgestaltet ist, dass er sich durch die Queröffnung (48) im oberen Bereich (46) des Knochenbefestigers (42) hindurch erstreckt und so eine Positionierung des Knochenbefestigers (42) in jeder gewünschten Stelle entlang der Längsachse des Beinbereichs (16) und um diese Achse herum ermöglicht; und

- einem Verriegelungselement (50), das dazu ausgestaltet ist, mit der Queröffnung (48) in dem Knochenbefestiger (42) in Eingriff zu geraten und so die Position des Knochenbefestigers (42) relativ zu dem Beinbereich (16) des Verbinders (10) festzulegen,

**dadurch gekennzeichnet, dass**

der Beinbereich (16) entlang seiner Längsachse gegabelt ist und so einen Querschlitz (28) definiert und zwei kompressible Bereiche, die sich senkrecht zu der Öffnung (18) in dem Körperbereich (14) erstrecken und diese schneiden, wobei die beiden kompressiblen Bereiche durch das Verriegelungselement (50) komprimiert werden, so dass der Verbinder (10) mit der Wirbelsäulenstange (12) verklemmt ist und die Position der Queröffnung (18) des Verbinders (10) relativ zu der Wirbelsäulenstange (12) fixiert ist.

2. System zur Fixierung der Wirbelsäule nach Anspruch 1, wobei der Schaftbereich (44) Knochengewinde beinhaltet.

3. System zur Fixierung der Wirbelsäule nach einem der vorangehenden Ansprüche, wobei die Querbohrung (48) weiter durch einen unteren Bereich definiert ist, in welchem ein halbzylindrischer Sitz definiert ist, um einen unteren Bereich des Beinbereichs (16) des Verbinders (10) aufzunehmen.

4. System zur Fixierung der Wirbelsäule nach einem der vorangehenden Ansprüche, wobei das Verriegelungselement (50) eine halbzylindrische Ausnehmung in seiner Bodenfläche beinhaltet, um einen oberen Bereich des Beinbereichs (16) des Verbinders (10) aufzunehmen.

5. System zur Fixierung der Wirbelsäule nach einem der vorangehenden Ansprüche, wobei der Querschlitz (28) in dem Beinbereich (16) ein zweites Ende hat, das an ein distales Ende des Beinbereichs (16) angrenzt.

6. System zur Fixierung der Wirbelsäule nach einem der Ansprüche 1 bis 4, wobei der Querschnitt (28) in dem Beinbereich (16) ein zweites Ende hat, das sich durch ein distales Ende des Beinbereichs (16) hindurch erstreckt.

7. System zur Fixierung der Wirbelsäule nach einem der Ansprüche 3 oder 4 bis 6, wenn abhängig von Anspruch 3, wobei die Querbohrung (48) in dem oberen Bereich des Knochenbefestigers (42) durch eine U-förmige Öffnung definiert ist mit einem Paar von gegenüberliegenden Seitenwänden und einem Boden, wobei in jeder Seitenwand ein sich verjüngender Eingriffsschlitz ausgeformt ist.

8. System zur Fixierung der Wirbelsäule nach Anspruch 7, wenn abhängig von Anspruch 4, wobei das Verriegelungselement (50) einen oberen Bereich und einen Bodenbereich beinhaltet, wobei der Bodenbereich ein Paar von gegenüberliegenden sich verjüngenden Rückhalteelementen zum Eingriff mit den sich verjüngenden Eingriffsschlitzen in den gegenüberliegenden Seitenwänden der U-förmigen Öffnung hat.

9. System zur Fixierung der Wirbelsäule nach einem der vorangehenden Ansprüche, wobei der obere Bereich des Verriegelungselements (50) ein Paar von zusätzlichen Rückhalteelementen beinhaltet, die von den gegenüberliegenden sich verjüngenden Rückhalteelementen beabstandet sind.

**Revendications**

1. Système de fixation du rachis comprenant :

   - une tige rachidienne (12) allongée ;
   - un élément de fixation d'os (42) ayant une partie supérieure (46) définissant un alésage transversal (48) et une partie de tige filetée (44) allongée dépendant de la partie supérieure (46) ;
   - un raccord (10) comprenant

     - une partie de corps (14) ayant une ouverture transversale (18) pour recevoir la tige

rachidienne (12) allongée, l'ouverture (18) étant configurée pour faciliter la rotation du raccord (10) autour de l'axe longitudinal de ladite tige rachidienne (12) et le mouvement longitudinal du raccord (10) le long de l'axe longitudinal de ladite tige rachidienne (12) ; et

- une partie de pied (16) s'étendant depuis la partie de corps (14) le long d'un axe s'étendant perpendiculairement à l'ouverture (18), la partie de pied (16) étant dimensionnée et configurée pour s'étendre à travers l'alésage transversal (48) dans la partie supérieure (46) de l'élément de fixation d'os (42), permettant ainsi à l'élément de fixation d'os (42) d'être positionné à un endroit désiré quelconque le long et autour de l'axe longitudinal de ladite partie de pied (16) ; et

- un élément de verrouillage (50) configuré pour s'engager dans ledit alésage transversal (48) dudit élément de fixation d'os (42) et fixer ainsi la position dudit élément de fixation d'os (42) par rapport à la partie de pied (16) du raccord (10)

**caractérisé en ce que**

ladite partie de pied (16) est bifurquée le long de son axe longitudinal, définissant ainsi une fente transversale (28) et deux parties compressibles s'étendant perpendiculairement à, et intersectant, l'ouverture (18) dans ladite partie de corps (14), dans lequel lesdites deux parties compressibles sont comprimées par ledit élément de verrouillage (50) afin que le raccord (10) soit serré sur ladite tige rachidienne (12) de façon que la position de l'ouverture transversale (18) du raccord (10) par rapport à la tige rachidienne (12) soit fixée.

2. Système de fixation du rachis selon la revendication 1, dans lequel la partie de tige (44) comprend des filetages à os.

3. Système de fixation du rachis selon l'une quelconque des revendications précédentes, dans lequel l'alésage transversal (48) est en outre défini par une partie inférieure dans laquelle un siège semi-cylindrique est défini pour recevoir une partie inférieure de la partie de pied (16) dudit raccord (10).

4. Système de fixation du rachis selon l'une quelconque des revendications précédentes, dans lequel l'élément de verrouillage (50) comprend un évidement semi-cylindrique dans sa surface inférieure afin de recevoir une partie supérieure de la partie de pied (16) dudit raccord (10).

5. Système de fixation du rachis selon l'une quelconque des revendications précédentes, dans lequel la fente transversale (28) située dans la partie de pied (16) a une deuxième extrémité adjacente à une extrémité distale de la partie de pied (16).

6. Système de fixation du rachis selon l'une quelconque des revendications 1 à 4, dans lequel la fente transversale (28) située dans la partie de pied (16) a une deuxième extrémité s'étendant à travers une extrémité distale de la partie de pied (16).

7. Système de fixation du rachis selon la revendication 3 ou l'une quelconque des revendications 4 à 6 dépendant de la revendication 3, dans lequel l'alésage transversal (48) dans la partie supérieure de l'élément de fixation d'os (42) est défini par une ouverture en U ayant une paire de parois latérales opposées et un fond, chaque paroi latérale ayant une fente d'engagement conique dans celle-ci.

8. Système de fixation du rachis selon la revendication 7 en dépendance de la revendication 4, dans lequel l'élément de verrouillage (50) comprend une partie supérieure et une partie inférieure, la partie inférieure ayant une paire d'éléments de retenue coniques opposés pour s'engager avec les fentes d'engagement coniques des parois latérales opposées de l'ouverture en U.

9. Système de fixation du rachis selon l'une quelconque des revendications précédentes, dans lequel la partie supérieure de l'élément de verrouillage (50) inclut une paire d'éléments de retenue supplémentaires distants des éléments de retenue coniques opposés.

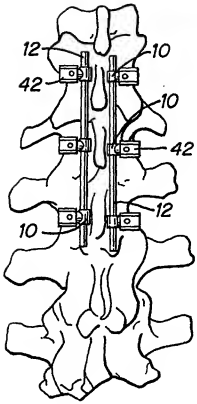


FIG_1

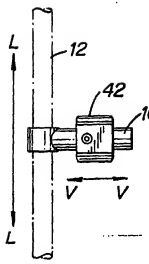


FIG_3

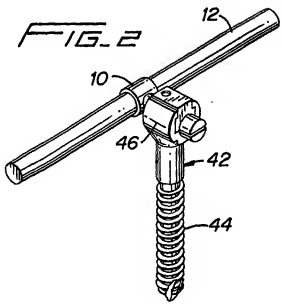


FIG_2

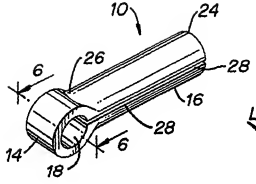


FIG. 4

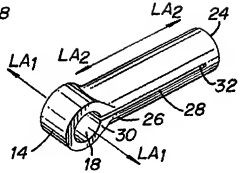


FIG. 5

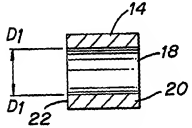


FIG. 6A

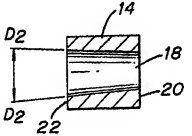


FIG. 6B

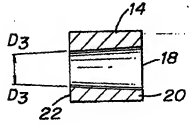


FIG. 6C

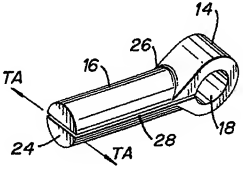


FIG. 7

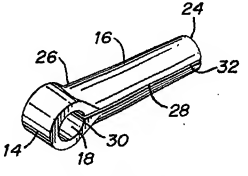


FIG. 8

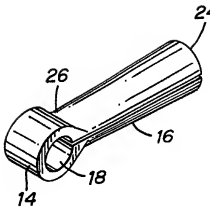


FIG_9

FIG_10

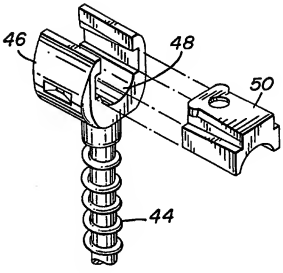


FIG_11

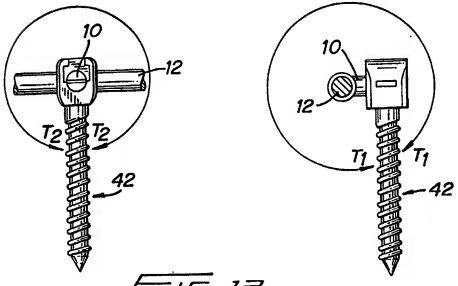


FIG_12

(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 1 297 792 B1

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(22) Date of filing: **08.05.1998**

(54) **Transverse spinal rod connector clip**

Querverbindungsklemme für Wirbelsäulenstäbe

Pince de liaison transversale pour tiges vertébrales

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(56) References cited:
**EP-A- 0 536 066**
**EP-A- 0 565 149**
**EP-A- 0 590 745**
**US-A- 5 439 463**



EP 1 297 792 B1

## Description

### BACKGROUND OF THE INVENTION

#### 1. Field of the Invention

**[0001]** The present invention relates to implantable spinal fixation systems for the surgical treatment of spinal disorders. More particularly, this invention relates to a transverse rod connector clip for connecting cylindrical rods to each other.

#### 2. Background of the Invention

**[0002]** For years doctors attempted to restore stability to the spine by fusion (arthrodesis) of the problem area. This treatment yielded marginal results due to the inherently flexible spinal column. Over the past ten years spinal implant systems have been developed to add stability to the spine to enhance the arthrodesis rates. Such systems often include spinal instrumentation having connective structures such as a pair of plates and/or rods which are placed on opposite sides of the portion of the spinal column which is intended to be fused. These spinal systems consist of screws and hooks for segmental attachment to the spine and longitudinal rods connected to screws or hooks. These components provide the necessary stability both in tension and compression yet yield minimal torsional control.

**[0003]** It has been found that when a pair of spinal rods are fastened in parallel on either side of the spinous process, the assembly can be significantly strengthened by using at least one additional rod to horizontally bridge the pair of spinal rods. A cross brace assembly is disclosed in U.S. Pat. No, 5,084,049. Devices such as these commonly consist of a threaded rod for providing the desired lateral support. The threaded rod is fastened to each of the spinal rods by damps located on each end of the threaded rod. However, this configuration is bulky and can cause irritation of the patient's back muscles and other tissue which might rub against the device. A cross brace assembly that fits closer to the spine, preferably in the same general plane as the vertical spinal rods, would reduce the complications associated with bulkier devices.

**[0004]** Most existing transverse connectors consist of rods, plates, and bars linked to the longitudinal rods by coupling mechanisms with set screws, nuts, or a combination of each. These connectors require several components and instruments to build the constructs. Each additional component or instrument required to assemble the connectors adds to the "fiddle factor" of the surgical technique. Examples of these transverse connectors include Tranverse Link Device (DLT) and Crosslink manufactured by Sofamor Danek, Trans-Connector manufactured by Synthes, and Modular Cross Connector and Transverse Rod Connector (TRC) manufactured by AcroMed.

**[0005]** Telescopic rod to rod couplers for use in a spinal implant systems have also been described. Prior to the locking member being engaged, the telescoping sections may be easily slid past their extremes and out of engagement with one another. While this is a convenient method of connecting and disconnecting the coupler sections, it can be inconvenient during surgery if the sections accidentally disengage. U.S. Patent No. 5,275,600 describes a telescopic rod to rod coupler in which the telescopic rod sections are assembled together using a 180 degree twisting motion. This is designed to minimize the risk of the rod sections accidentally disconnecting during the implant procedure.

**[0006]** Presently available spinal fixation systems frequently require careful alignment of the hardware used to connect the components of the spinal instrumentation with each other. A need has thus arisen for improved rod connectors to transversely connect spinal rods without requiring additional manipulation of the spinal instrumentation and to minimize the use of pedicle screws while at the same time reducing requirements to assemble small pieces of hardware during the surgical procedure.

**[0007]** Further, there are different rod connectors in the state of the art, like the mechanism of EP 0 590 745 A2. A spinal clamping device including a spinal clamping member, a clamping adjusting member, a distance adjusting bar, and a distance adjusting and fastening member is disclosed in US 5 439 463 on which the preamble of claim 1 is based.

### SUMMARY OF THE INVENTION

**[0008]** The present invention is directed to transverse connector clips for connecting cylindrical rods in spinal fixation systems and provides a spinal fixation system according to claim 1. Preferred embodiments of the invention are defined in the dependent claims.

**[0009]** The transverse connector clips of the present invention can be used to transversely connect spinal rods without requiring additional manipulation of the spinal instrumentation. Because the clips of the present invention do not require any additional locking mechanism, they reduce the assembly of small pieces of hardware during the surgical procedure.

### BRIEF DESCRIPTION OF THE DRAWINGS

**[0010]**

Figure 1 is a top perspective view of a transverse connector clip;

Figure 2 is a perspective view of one embodiment of the transverse connector clip of the present invention with a short, laterally extending bar;

Figure 3 is a top perspective view of another embodiment of a transverse connector clip of the present invention with a laterally extending bar hav-

ing a plurality of vertical teeth;

Figure 4 is a bottom perspective view of the invention clip of Fig. 3;

Figure 5 is a perspective view of a pair of the connecting transverse connector dips of Figure 3;

Figure 6 is a perspective view of the clip of Fig. 2 securing the transverse connector clips of Fig. 5;

Figure 7 is a schematic view of spinal rods implanted in a human spine and illustrating the method of assembly;

Figure 8 is a top perspective view of another transverse connector clip;

Figure 9 is a bottom perspective view of the connector clip of Fig. 8;

Figure 10 is perspective view of the connector clip of Fig. 8 illustrating the connecting mechanism of the connector clip;

Figure 11 is a perspective view of the connector clip of Fig. 8 connected to the ends of an T-bar;

Figure 12 is a perspective view of an another embodiment of the present invention illustrating the method of assembly of two connector dips having laterally extending tapered bars connected together with a tapered sleeve;

Figure 13 is a perspective view of the invention of Fig. 12 illustrating a range of lateral adjustment between the two clips;

Figure 14 is a schematic view of the invention of Fig. 13 connected to spinal rods implanted in a human spine and illustrating the method of assembly;

Figure 15 is a perspective view of another spinal fixation system illustrating the method of assembly; and

Figure 16 is a perspective view of the assembled spinal fixation system of Fig. 15.

## DETAILED DESCRIPTION OF INVENTION

**[0011]** The present Invention is directed to a transverse connector clip 10 and assemblies used in spinal fixation systems. Spinal fixation systems typically include spinal instrumentation having connective structures such as a pair of plates and/or rods which are placed on opposite sides of the spinal column near vertebrae that are intended to be fused. These spinal systems consist of screws and hooks for segmental attachment to the spine and longitudinal rods connected to screws or hooks. These components provide the necessary stability both in tension and compression yet yield minimal torsional control. In addition, it has been found that when a pair of spinal rods are fastened in parallel on either side of the spinous process, the assembly can be significantly strengthened by using at least one additional rod to horizontally bridge the pair of spinal rods.

**[0012]** The transverse connector clips 10 consist of a component with a means to dip the device on a spinal or cylindrical rod 11 and a component with a means to link two rod connectors together laterally. Transverse connector dip 10 concept consists of a clip body 12 with a first side 14 and a second side 16 (Figure 1). On first side 14 are two, mirror image hemi-cylindrical shells 18 and 20. These two, mirror image hemi-cylindrical shells 18 and 20 have an inner surface 24 that defines a rod bore 26 through which the cylindrical rod 11 can extend. Rod bore 26 has an inner diameter 22 that is designed to be slightly smaller than the outer diameter of the cylindrical rod 11 it will receive. Top surface 28 of the hemi-cylindrical shells 18 and 20 defines an outer diameter 30.

**[0013]** It should be noted that the two, mirror image hemi-cylindrical shells 18 and 20 can be connected to the first side 14 of clip body 12 as shown in clip 10 A of Figure 2 or in minor image relationship as shown in clip 10A of Figure 6.

**[0014]** Clip body 12 is placed on the cylindrical rod 11 at 90 degrees and turned so that the hemi-cylindrical shells 18 and 20 spread around the rod 11. The deflection of the hemi-cylindrical shells 18 and 20 and the inner diameter of the shells 22 allow the clip 10 to securely damp on the rod 11.

**[0015]** The second side of the clip body 12 can include, but is not limited to, a short hemi-cylinder rod (Clip 10A, Figure 2), a laterally extending hemi-cylinder rod with a plurality of vertical teeth (Clip 10B, Figures 3-4), a second pair of mirror image hemi-cylindrical shells (Clip 10C, Figures 8-9), a laterally extending rod tapering from a proximal cylindrical shape to a distal hemi-cylinder shape (Clip 10D, Figure 12), or an outwardly extending U-shaped receptacle designed to receive a semi-cylindrical or cylindrical rod and a locking cap device (Clip 10E, Figures 15-16). Each of these embodiments will be described below.

**[0016]** One embodiment of the transverse connector clip 10A is shown in Figure 2. Here, the clip body 12 consists of a first side 14 as previously described (Figure 1) and a second side 16 that comprises a preferably short laterally extending hemi-cylinder rod 40, however, any shaped rod could be utilized. The short hemi-cylinder rod 40 integral to the second side 16 of clip body 12 is shaped to facilitate installation of dip 10A by a user. A user can use the short rod 40 to manually engage and disengage the dip body 12 from a cylindrical rod 11 of two rods joined together in a spinal fixation system. clip 10A can be used to connect transverse connector dips having laterally extending hemi-cylinder rods 10B (Figure 6). One advantage of the inventive connector clip 10A over prior art connectors is that dip 10A is a single piece connector, thereby reducing the amount of assembly of the spinal fixation system required by prior art connectors during surgery.

**[0017]** Another embodiment of the present invention is the transverse connector clip 10B (Figure 3). Here, the clip body 12 consists of a first side 14 as previously described (Figure 1) and a second side 16 that includes

a laterally extending hemi-cylinder rod 50 having a first side 52, a second side 54, and a longitudinal axis LA1-LA1. However, other shapes can be utilized for the laterally extending hemi-cylinder rod 50. The first side 52 contains a plurality of vertically placed teeth 56 extending along the longitudinal axis LA1-LA1. Figure 4 shows a perspective view of the second side 54 of connector clip 10B.

**[0018]** Clip 10B is designed to be interlocked to a second clip 10B (Figure 5). The first sides 52 of the hemi-cylinder rods 50 are connected to each other via the plurality of vertical teeth 56 extending along the longitudinal axes LA1-LA1 of the hemi-cylinder rods 50. The dips 10B can transversely connect two longitudinal rods 11 placed at varying distances from each other with the plurality of teeth 56 accommodating the variable distance. This variable distance is indicated by the lateral motion arrows LM1-LM1 (Figure 5). This ability of the clips 10B provides a significant advantage during surgery where many such adjustments are necessary to fine tune the alignment of the assembly in the patient

**[0019]** The connection between dips 10B can be maintained by using transverse connector clip 10A (Figure 6). When the first sides 52 of the hemi-cylinder rods 50 are engaged by the interlocking of the plurality of vertical teeth 56, the second sides 54 form a cylindrical rod having a diameter that is slightly larger than the inner diameter 22 defined by the inner surface 24 of the hemi-cylindrical shells 18 and 20 of clip 10A. Thus, the hemi-cylindrical shells 18 and 20 of clip 10A can snap onto the connected hemi-cylinder rods 50 of clips 10B as if the connected hemi-cylinder rods 50 were a single cylindrical rod 11.

**[0020]** While Figure 6 illustrates a transverse connector clip 10A of the present invention connecting the laterally extended hemi-cylinder rods 50 of clips 10B, it should be understood that any connecting device known to one skilled in the art can be used to connect the hemi-cylinder rods 50. The advantage of using the transverse connector clip 10A of the present invention, however, is that it consists of a single piece which facilitates surgery by reducing the number of pieces that need to be assembled.

**[0021]** The spinal rod assembly using transverse connector dips 10A and 10B of the present invention connects to longitudinal rods 11 that are connected to a human vertebrae 91 as schematically shown in Figure 7. Two cylindrical rods 11 are each connected to a transverse connector clip 10B through the mirror image hemi-cylindrical shells 18 and 20. The laterally extending hemi-cylinder rods 50 of clips 10B are connected to each other by the interlocking of the plurality of vertical teeth 56. This connection is maintained by clip 10A.

**[0022]** Clip 10C (Figures 8-9) is an alternate transverse clip connector 10 having a clip body 12 with a first side 14 and a second side 16. The first side 14 is as previously described (Figure 1). The second side 16 of the clip body 12 comprises a second set of mirror image hemi-cylindrical shells 60 and 62. Like the hemi-cylindrical shells 18 and 20 on the first side 14 of clip body 12, hemi-cylindrical shells 60 and 62 can be placed on the second side 16 of the clip body 12 as shown (Figure 8) or in mirror image relationship (not shown).

**[0023]** The second set of hemi-cylindrical shells 60 and 62 have an outer surface 64 and an inner surface 68. The inner surface 68 defines a rod bore 70 through which a cylindrical rod 88 can extend. Rod bore 70 has a diameter 72 that is slightly smaller than the diameter of the rod 88 it is designed to receive.

**[0024]** Clip 10C is designed to simultaneously connect two longitudinal rods 11 and a transverse rod 88 together. The cylindrical rods 11 connect to the first side 14 of the clip body 12 as previously described. Cylindrical rod 88 connects to the second side 16 of clip body 12 in a similar fashion. Namely, clip body 12 is placed on a cylindrical rod 88 at 90 degrees and turned so that the hemi-cylindrical shells 60 and 62 spread around the rod 88. The deflection of the hemi-cylindrical shells 60 and 62 and the inner diameter 72 allow the clip body 12 of clip 10C to securely damp on the rod 88.

**[0025]** One advantage of having the second side 16 of the inventive clip body 12 comprising a second pair of hemi-cylindrical shells 60 and 62 is that it allows attachment of this second pair of shells 60 and 62 to various other rod types used in spinal surgery such as T-bar 80 (Figure 10) and an I-bar (not shown). A T-bar 80 and an I-bar can horizontally bridge a pair of cylindrical rods 11 (Figure 11) significantly strengthening the spinal fixation system.

**[0026]** T-bars 80 have a longitudinal body 82, a first end 84 and a second end 86. The first end 84 of T-bar body 82 has a cylindrical-shaped bar 88 perpendicularly connected to the T-bar body 82 (Figure 10). This bar 88 can be connected to the second pair of hemi-cylindrical shells 60 and 62 of invention clip 10C as described above.

**[0027]** Two clips 10C can be used to connect two cylindrical rods 11 via two T-bars 80 (Figure 11). In this example, two dips 10C are each connected to bars 88 on the first ends 84 of two separate T-bar bodies 82. The second ends 86 of each T-bar body 82 is then connected to each other via a tapered locking sleeve 90 or by any means known to those of skill in the art The relative placement of one cylindrical rod 11 to the other can be adjusted by adjusting the T-bar connection as indicated by circular motion arrows CM1-CMI and CM2-CM2. In this way, the clips 10C can facilitate the creation of the desired transverse bridge between two cylindrical rods 11 using a minimum number of pieces.

**[0028]** While the embodiment shown here (Figure 11) shows clips 10C connected to two different T-bars 80, it should be understood that two clips 10C can also be connected to the opposite ends of a single I-bar (not shown). An I-bar has a longitudinal body and a first and second end. The first end has a first rod-shaped bar positioned perpendicular to the I-bar body. The second end

has a second cylindrical-shaped bar positioned perpendicular to the I-bar body. The first pair of hemi-cylindrical shells 18 and 20 of clip 10C is connected to a first cylindrical rod 11 while the second pair of hemi-cylindrical shells 60 and 62 is connected to the first bar on the first end of the I-bar body. A second clip 10C is connected to a second cylindrical rod 11 through hemi-cylindrical shells 18 and 20 and then to the second bar on the second end of the I-bar body via hemi-cylindrical shells 60 and 62. In this way, the I-bar provides a horizontal bridge between two cylindrical rods by connection via the clips 10C.

**[0029]** In another embodiment of the inventive clip 10, the first side of the clip body 12 is as previously described, while the second side of the clip body 12 comprises a laterally extending rod 100 having a first side 102, a second side 104, a longitudinal axis LA1-LA1, and a proximal 106 and distal 108 end (Clip 10D, Figure 12). The proximal end 106 is cylindrical in shape and tapers to a hemi-cylindrical shape at the distal end 108.

**[0030]** Clip 10D is designed to connect to another clip 10D (Figures 12-14) via the laterally extending tapering rods 100. The laterally extending tapered rods 100 are connected to each other by mating the first sides 102 together. This connection can be maintained with any of the devices known to those of skill in the art including, but not limited to, a tapered locking sleeve 90. This tapered locking sleeve 90 consists of an inner 92 and outer 94 sleeve portion. Inner sleeve portion 92 has an inner surface 96 and outer surface 98; and outer sleeve portion 94 has an inner surface 110 and outer surface 112. The outer surface 98 of the inner portion 92 has a diameter 114 slightly smaller than a diameter 116 of the inner surface 110 of the outer sleeve 94 so as to allow the inner sleeve portion 92 to be placed concentrically inside the outer sleeve 94 in order to lock the inner sleeve portion 92 and outer sleeve portion 94 together.

**[0031]** To assemble clips 10D, the outer sleeve portion 94 is positioned on a laterally extending hemi-cylinder bar 100 of a first connector clip 10D and the inner sleeve portion 92 is positioned on a laterally extending hemi-cylinder bar 100 of a second connector clip 10D (Figures 12-14). The first sides 102 of the laterally extending hemi-cylinder bars 100 of the first and second clips 10D are mated and held in locking engagement by the tapered sleeve 90.

**[0032]** The distance between the two connector clips 10D can be laterally adjusted by moving the laterally extending tapered rods 100 as indicated by the arrows LM2-LM2 in Figure 13. When the first sides 14 of each clip body 12 of clips 10D are connected to two different cylindrical rods 11 via the hemi-cylindrical shells 18 and 20 on the first side 14 of the clip body 12 (Figure 14), lateral adjustment of the tapered rods 100 laterally adjusts the relative position of the cylindrical rods 11 to which the connector clips 10D are connected. This provides the user with some flexibility in adjusting the alignment of the cylindrical rods 11 in a spinal fixation apparatus during surgery.

**[0033]** A spinal rod assembly using connector clips 10D and a tapered locking sleeve 90 connects to longitudinal rods 11 that are connected to a human vertebrae 91 as schematically shown in Figure 14. Two cylindrical rods 11 are each connected to a clip 10D through the mirror image hemi-cylindrical shells 18 and 20. The laterally extending tapered bars 100 of clips 10D are held together with a tapered locking sleeve 90. The assembly of the tapered locking sleeve 90 is also shown.

**[0034]** Several means of clamping the various types of laterally extending rods from the second side 16 of the invention clip body 12 have been described above including another transverse clip of the present inventive clip 10A (Figure 6) and a tapered sleeve 90 (Figures 12-14). However, it should be understood that laterally extending hemi-cylinder rods can be connected by any other connecting means known to one skilled in the art

**[0035]** in yet another example of a transverse connector clip 10, the first side 14 of the clip body 12 is as previously described, while the second side 16 of the clip body 12 comprises an outwardly extending rod holding portion 120 and a locking mechanism 130. The rod holding portion has a longitudinal axis positioned perpendicular to the longitudinal axis LA1-LA1 of the first side 14 of the clip body 12. The locking mechanism 130 is configured to engage with the rod holding portion 120 In order to locking the longitudinal rod into the rod holding portion 120. The rod holding portion can be in the shape of a solid holding portion having a through bore for receiving a hemi-cylindrical or cylindrical rod and the locking mechanism can be of any locking mechanism known to one skilled in the art, such as tapered locking caps, set screws or locking nuts. In one example, the holding portion is a U-shaped holding portion 120 having a longitudinal axis LA3-LA3 positioned perpendicular to the longitudinal axis LA1-LA1 of the first side 14 of connector clip 10E (Figures 14-15). The U-shaped holding portion 120 has an upper portion 122 and a lower portion 124. The lower portion 124 is configured to receive a flat side 126 of a hemi-cylindrical rod 128. Alternatively (not shown), the lower portion 124 of the U-shaped portion 120 can be configured to receive a cylindrical rod 11. A locking mechanism for the U-shaped portion 120 can include a locking cap 130 with an upper 132 and lower side 134 configured to slide into and mate with the upper portion 122 of U-shaped portion 120. Upper side 132 of locking cap 130 has a tapered portion 136 that engages and mates with a tapered portion 138 In the upper portion 122 of the U-shaped portion 120. The lower side 134 of the locking cap 130 is configured to accommodate an arcuate side 140 of the hemi-cylindrical rod 128.

**[0036]** The advantage of the clip 10E, when used in combination with the locking cap 130, the hemi-cylinder support bar 128, and cylindrical rod 11 (Figure 15-16) is that connecting clip 10E is a single piece that connects two rods together, thus reducing the requirement of the prior art connectors to assemble small pieces of hard-

ware during the surgical procedure.

**[0037]** It should be understood that in keeping with spinal surgery techniques, a plurality of cylindrical rods 11 can be used, each with a plurality of attachment devices affixed thereto, with the present attachment devices transversely connecting either two rods 11 together or connecting portions of rods together in other alignments.

**[0038]** The foregoing disdosure and description of the invention are illustrative and explanatory thereof, and various changes in the details of the illustrated apparatus and construction and method of operation may be made without departing from the scope of the invention as defined by the appended claims.

## Claims

1. A spinal fixation system comprising: a first clip body (10) having a pair of opposed spaced apart arcuate rod engaging hooks (20, 18) for engaging a first elongated spinal rod, and a laterally extending transverse connector (100); a second clip body (10) having a pair of opposed spaced apart arcuate rod engaging hooks (20, 18) for engaging a second elongated spinal rod, and a laterally extending transverse connector (100) and a fastener (90) for securing the transverse connector (100) of the first clip body (10) and the transverse connector (100) of the second clip body (10) to one another, **characterized in that** the fastener (90) has an inner portion (92) with an outer surface (98) and an outer portion (94) with an inner surface (110), the inner surface (110) of the outer portion (94) being sized to allow the inner portion (92) to be placed inside the outer portion (94) to lock the inner and outer portion (92, 94) together.

2. A spinal fixation system as recited in claim 1, wherein the transverse connector (100) extending from the first clip body (10) and the transverse connector (100) extending from the second clip body (10) have complementary cross-sectional configurations such that together the pair of transverse connectors define a circular cross-section.

3. A spinal fixation system as recited in any of the preceding claims, wherein the fastener (90) is defined at least in part by a cylindrical compression sleeve.

4. A spinal fixation system as recited in any of the preceding claims, wherein the transverse connector (100) extending from the first clip body (10) and the transverse connector (100) extending from the second clip body (10) have complementary mating surfaces (102).

5. A spinal fixation system as recited in any of the preceding claims, wherein the complementary mating surfaces (102) are substantially planar and wherein the complementary mating surfaces (102) have interlocking teeth formed thereon.

6. A spinal fixation system as recited in any of the preceding claims, wherein each elongated clip body (10) has a second pair of opposed arcuate engaging hooks depending from a second side thereof, and the transverse connector (100) includes a perpendicular rod portion for reception by the second pair of arcuate engaging hooks (60, 62).

## Patentansprüche

1. Ein Wirbelsäulenfixierungssystem, aufweisend:

   einen ersten Klemmkörper (10) mit einem Paar von entgegengesetzt angeordneten bogenförmigen Stabgreifhaken (20; 18) zum Greifen eines ersten verlängerten Wirbelsäulenstabs und einen sich in Querrichtung erstreckenden Querverbinder (100);
   einen zweiten Klemmkörper (10) mit einem Paar von entgegengesetzt angeordneten bogenförmigen Stabgreifhaken (20; 18) zum Greifen eines zweiten verlängerten Wirbelsäulenstabs und einen sich in Querrichtung erstreckenden Querverbinder (100), und ein Befestigungselement (90) zur Befestigung des Querverbinders (100) des ersten Klemmkörpers (10) mit dem Querverbinder (100) des zweiten Klemmkörpers (10), **dadurch gekennzeichnet, dass** das Verbindungselement (90) ein inneres Teil (92) mit einer Außenfläche (98) und ein äußeres Teil (94) mit einer Innenfläche (110) aufweist, wobei die Innenfläche (110) des äußeren Teils (94) derart bemessen ist, dass das innere Teil (92) in das äußere Teil (94) einsetzbar ist, um das innere und äußere Teil (92, 94) miteinander zu verriegeln.

2. Ein Wirbelsäulenfixierungssystem nach Anspruch 1, **dadurch gekennzeichnet, dass** der sich vom ersten Klemmkörper (10) erstreckende Querverbinder (100) und der sich vom zweiten Klemmkörper (10) erstreckende Querverbinder (100) komplementäre Querschnittskonfigurationen aufweisen, wobei die beiden Querverbinder zusammen einen kreisförmigen Querschnitt definieren.

3. Ein Wirbelsäulenfixierungssystem nach einem der vorhergehenden Ansprüche, **dadurch gekennzeichnet, dass** das Befestigungselement (90) mindestens teilweise durch eine zylindrische Spannhülse definiert ist.

4. Ein Wirbelsäulenfixierungssystem nach einem der vorhergehenden Ansprüche, **dadurch gekennzeichnet, dass** der sich von dem ersten Klemmkörper (10) erstreckende Querverbinder (100) und der sich von dem zweiten Klemmkörper (10) erstreckende Querverbinder (100) komplementäre Paarflächen (102) aufweisen.

5. Ein Wirbelsäulenfixierungssystem nach einem der vorhergehenden Ansprüche, **dadurch gekennzeichnet, dass** die komplementären Paarflächen (102) im Wesentlichen plan sind, wobei die komplementären Paarflächen (102) ineinandergreifende Zähe aufweisen.

6. Ein Wirbelsäulenfixierungssystem nach einem der vorhergehenden Ansprüche, **dadurch gekennzeichnet, dass** jeder verlängerte Klemmkörper (10) ein zweites Paar von entgegengesetzten bogenförmigen Greifhaken, die von einer zweiten Seite ausgehen, aufweist und der Querverbinder (100) einen rechtwinkligen Stabteil zur Aufnahme durch das zweite Paar von bogenförmigen Greifhaken (60; 62) aufweist.

**Revendications**

1. Système de fixation pour colonne vertébrale comprenant : un premier corps de pince (10) ayant une paire de crochets (20, 18) d'accouplement arqués, opposés et distants destinés à s'engager avec une première tige vertébrale allongée, et un raccord transversal (100) s'étendant latéralement ; un deuxième corps de pince (10) ayant une paire de crochets (20, 18) d'accouplement arqués, opposés et distants destinés à s'engager avec une deuxième tige vertébrale allongée, et un raccord transversal (100) s'étendant latéralement et une attache (90) pour fixer le raccord transversal (100) du premier corps de pince (10) et le raccord transversal (100) du deuxième corps de pince (10) l'un à l'autre, **caractérisé en ce que** l'attache (90) a une portion intérieure (92) dotée d'une surface extérieure (98) et une portion extérieure (94) dotée d'une surface intérieure (110), la surface intérieure (110) de la portion extérieure (94) ayant une dimension permettant à la portion intérieure (92) de se placer à l'intérieur de la portion extérieure (94) pour bloquer ensemble les portions intérieure et extérieure (92, 94).

2. Système de fixation pour colonne vertébrale selon la revendication 1, dans lequel le raccord transversal (100) s'étendant depuis le premier corps de pince (10) et le raccord transversal (100) s'étendant depuis le deuxième corps de pince (10) ont des configurations complémentaires en section transversale de façon que la paire assemblée de raccords transversaux définisse une section transversale circulaire.

3. Système de fixation pour colonne vertébrale selon l'une quelconque des revendications précédentes, dans lequel l'attache (90) est définie au moins en partie par un manchon cylindrique à comprimer.

4. Système de fixation pour colonne vertébrale selon l'une quelconque des revendications précédentes, dans lequel le raccord transversal (100) s'étendant depuis le premier corps de pince (10) et le raccord transversal (100) s'étendant depuis le deuxième corps de pince (10) ont des surfaces de contact (102) complémentaires.

5. Système de fixation pour colonne vertébrale selon l'une quelconque des revendications précédentes, dans lequel les surfaces de contact (102) complémentaires sont sensiblement planes et dans lequel des dents imbriquées sont formées sur les surfaces de contact (102) complémentaires.

6. Système de fixation pour colonne vertébrale selon l'une quelconque des revendications précédentes, dans lequel chaque corps de pince (10) allongé a une deuxième paire de crochets d'accouplement arqués, opposés dépendant de son deuxième côté, et le raccord transversal (100) comprend une portion perpendiculaire de tige destinée à recevoir la deuxième paire de crochets d'accouplement arqués (60, 62).

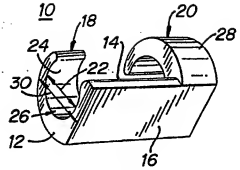


FIG. 1

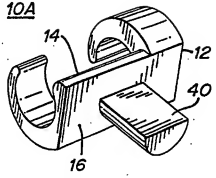


FIG. 2

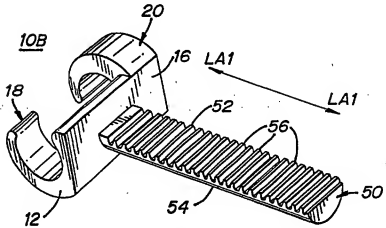


FIG. 3

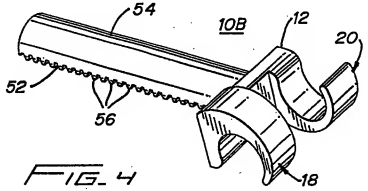


FIG. 4

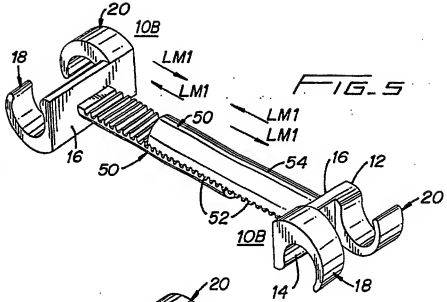


FIG_5

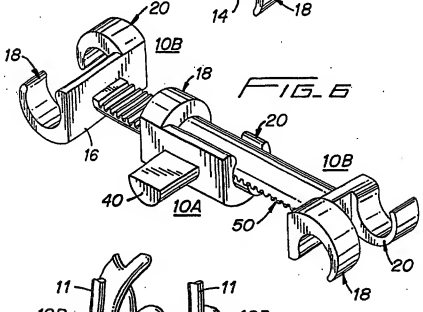


FIG_6

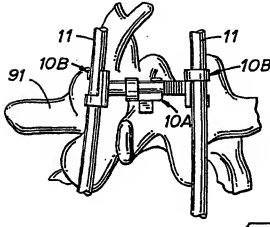


FIG_7

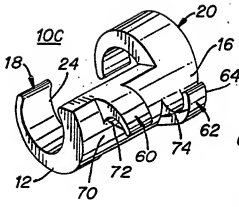


FIG. 8

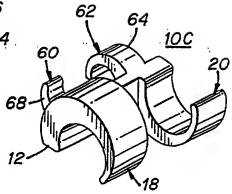


FIG. 9

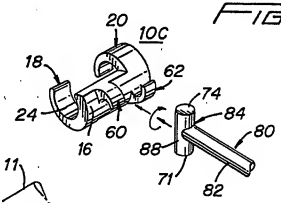


FIG. 10

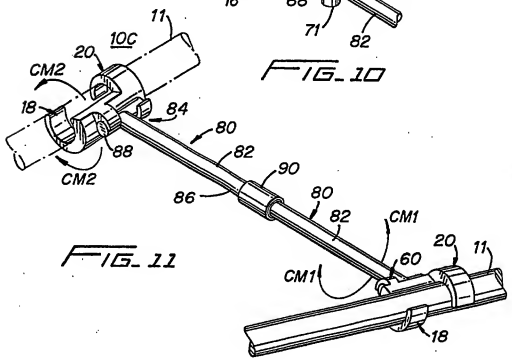


FIG. 11

FIG. 12

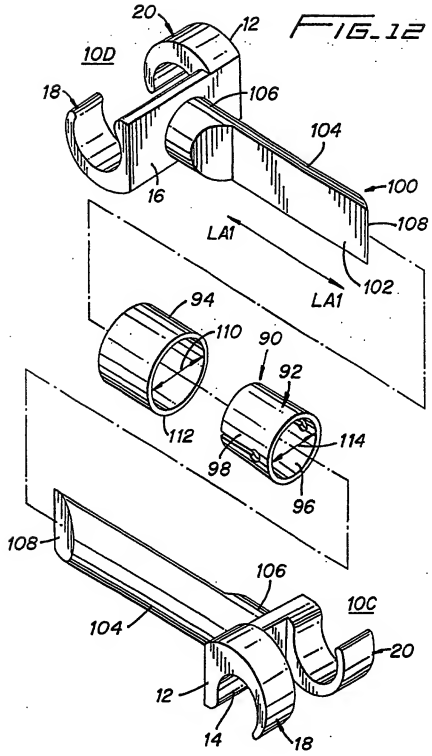
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FIG. 13

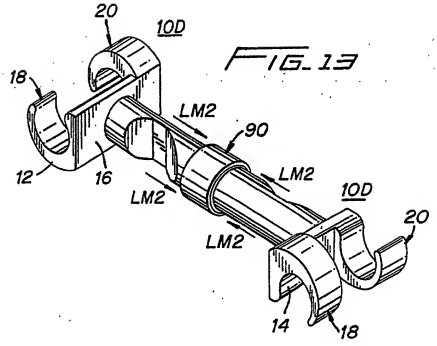
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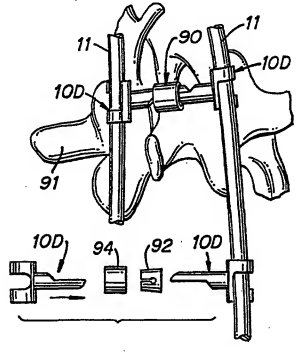
FIG. 14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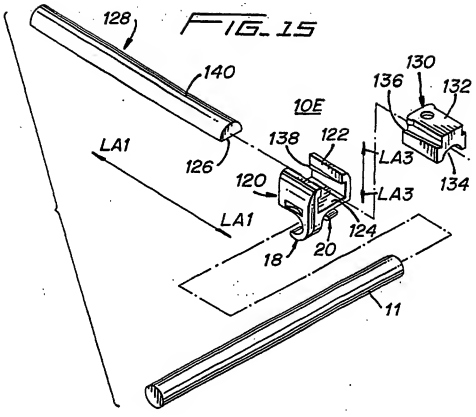
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FIG. 15

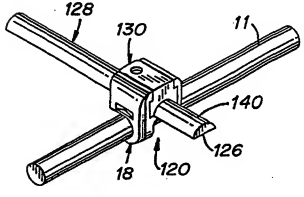
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FIG. 16

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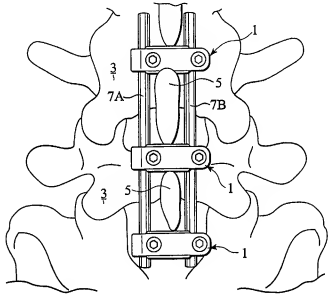
## (54) Vertebral body distance retainer

(57) A vertebral body distance retainer comprises a retainer member including engaging portions to be engaged with a pair of rods provided on a plurality of adjacent vertebral bodies and abutting portions capable of freely abutting on spinous processes of the adjacent vertebral bodies, and fixing screws which fix the rods being engaged with the engaging portions. The vertebral body distance retainer is disposed between the spinous processes each existing on the adjacent vertebral bodies, so that the distance between the spinous processes can be retained constant.

FIG. 2




EP 1 334 703 A2

## Description

### BACKGROUND OF THE INVENTION

1. Field of the Invention

**[0001]** The present invention relates to a vertebral body distance retainer for constantly retaining a distance between spinous processes by disposing the retainer between spinous processes each existing on adjacent vertebral bodies. More specifically, the present invention relates to a vertebral body distance retainer capable of effectively controlling displacement of the vertebral bodies.

2. Description of the Related Art

**[0002]** A device shown in FIG. 1A and FIG. 1B is known as a proposed vertebral body distance retainer for retaining a distance between spinous processes, which is disposed between the spinous processes each existing on adjacent vertebral bodies. This vertebral body distance retainer 101 has the constitution in which control plates 105 each protruding outward are provided on both end portions of a U-shaped retainer member 103.

**[0003]** As shown in FIG. 1B, the vertebral body distance retainer 101 has the constitution in which the retainer member 103 is disposed between spinous processes 109 each existing on adjacent vertebral bodies 107 and the control plates 105 provided on the retainer member 103 are engaged with side surfaces of the spinous processes 109.

### SUMMARY OF THE INVENTION

**[0004]** However, since the proposed distance retainer 101 is designed to be simply placed between the spinous processes 109, the distance retainer 101 has a problem in terms of stability upon fixing a position between the vertebral bodies.

**[0005]** The present invention has been made in consideration of the above problems. It is an object of the present invention to provide a vertebral body distance retainer capable of tightly fixing adjacent vertebral bodies to achieve high stability.

**[0006]** To achieve the object described above, the present invention provides a vertebral body distance retainer, comprising: a retainer member including engaging portions to be engaged with a pair of rods provided on a plurality of adjacent vertebral bodies, and abutting portions capable of freely abutting on spinous processes of the adjacent vertebral bodies; and fixing screws which fix the rods, the rods being engaged with the engaging portions, wherein the vertebral body distance retainer is disposed between the spinous processes each existing on the adjacent vertebral bodies, so that the distance between the spinous processes can be retained constant.

### BRIEF DESCRIPTION OF THE DRAWINGS

**[0007]** The invention will now be described with reference to the accompany drawings wherein;

FIG. 1A and FIG. 1B are schematic views showing a structure of a proposed vertebral body distance retainer;
FIG. 2 is a schematic view showing a structure of a vertebral body distance retainer according to an embodiment of the present invention;
FIG. 3A is a top plan view showing a structure of a vertebral body distance retainer according to an embodiment of the present invention; and
FIG. 3B is a cross-sectional view showing a structure of a vertebral body distance retainer according to an embodiment of the present invention.

### DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

**[0008]** Hereinafter, description will be made of embodiments of the present invention with reference to the drawings.

**[0009]** As shown in FIG. 2, a vertebral body distance retainer 1 according to an embodiment of the present invention is disposed and used between spinous processes 5 each existing on adjacent vertebral bodies 3. Upon fixation thereof, the vertebral body distance retainer 1 is fixed to a pair of rods 7A and 7B, which are disposed so as to sandwich the spinous processes 5.

**[0010]** FIG. 2 shows a constitution example in which the vertebral body distance retainers 1 are each fitted to both ends of the pair of rods 7A and 7B so that the rods 7A and 7B are fixed by allowing the vertebral body distance retainers 1 to abut respectively on the spaced spinous processes 5. However, as the constitution for fixing the pair of rods 7A and 7B, it is also possible to apply a constitution in which a plurality of implants such as screws are each screwed and fixed to the spaced vertebral bodies 3 so that the both end portions of the rods 7A and 7B are fixed to the plurality of implants. Otherwise, it is also possible to apply a constitution in which a hook is provided on one end of each of the rods 7A and 7B so that each of the hooks is hanged and fixed on a pedicle of vertebral arch existing on the vertebral body. It is possible to apply various types of constitutions for fixing the pair of rods 7A and 7B as appropriate.

**[0011]** As shown in FIG. 3A and FIG. 3B, the vertebral body distance retainer 1 includes a plate type retainer member 9. On both ends in the width direction of the retainer member 9, abutting portions 11 that can freely abut on the spinous processes 5 are formed. Moreover, outer edges 13 of the abutting portions 11 are each formed into sharp blades so that the outer edges 13 can bite into the spinous processes 5.

**[0012]** Engaging portions 15 and 17 for engaging with the pair of rods 7A and 7B are provided on a lower side of the retainer member 9 along the longitudinal direction of the retainer member 9 with a space provided therebetween. The engaging portions 15 and 17 are formed so as to have apertures in the same direction. Accordingly, the engaging portions 15 and 17 are each formed into semicircular shapes corresponding to diameters of the pair of rods 7A and 7B. Moreover, fixing screws 19 are screwed in the vicinity of the apertures of the engaging portions 15 and 17, and tip portions (lower end portions) of the fixing screws 19 are formed into tapers which provide taper faces 21 so that the tip portions can freely abut on outer peripheries of the rods 7A and 7B engaged with the engaging portions 15 and 17.

**[0013]** In the above-described constitution, the retainer member 9 of the vertebral body retainer 1 is disposed between the spinous processes 5 each existing on the adjacent vertebral bodies 3, and the spinous processes 5 are abutted on the abutting portions 11 provided on the both sides of the retainer member 9. Moreover, the engaging portions 15 and 17 provided on the retainer member 9 are engaged with the pair of rods 7A and 7B disposed on the both sides of the spinous processes 5, and then the fixing screws 19 are tightened. In this way, the rods 7A and 7B, and the retainer member 9 are integrated.

**[0014]** When the pair of rods 7A and 7B is integrated with the retainer member 9 as described above, the distance between the rods 7A and 7B are retained constantly by the retainer member 9, and movements of the rods 7A and 7B are thereby controlled. In other words, in the state where the both end portions of the rods 7A and 7B are fixed to the spaced vertebral bodies 3 with the implants such as a plurality of screws provided therebetween, the retainer member 9 is fixed to the rods 7A and 7B.

**[0015]** Therefore, the vertebral bodies 3 in the spaced positions are retained in the constant distance with the rods 7A and 7B fixed thereto, and the distance between the spinous processes 5 located on the both sides of the retainer member 9 are controlled by the retainer member 9. Accordingly, movements of the vertebral bodies 3 toward a mutually approaching direction are controlled. Moreover, in the state where the blades provided on the both side portions of the retainer member 9 bite slightly into the spinous processes 5, relative movements of the adjacent spinous processes 5 are restricted, whereby displacement of the vertebral bodies 3 is effectively controlled.

**[0016]** Moreover, when the rods 7A and 7B are fixed to the engaging portions 15 and 17 by tightening the fixing screws 19, the rods 7A and 7B are tightly pressed into the engaging portions 15 and 17 by wedge effects of the taper faces 21 provided on the fixing screws 19. Furthermore, the fixing screws 19 are located in the positions which are shifted inward from the central axes of the rods 7A and 7B, i.e. toward the aperture sides. Hence, the taper faces 21 provided on the tip portions of the fixing screws 35 abut on the outer peripheries of the rods 7A and 7B when the fixing screws 35 are tightened and act to press the rods 7A and 7B obliquely downward. Accordingly, the rods 7A and 7B can be surely fixed by pressure into inner peripheries of the engaging portions 15 and 17. In addition, the tip portions of the fixing screws 19 narrow the apertures of the engaging portions 15 and 17, whereby the rods 7A and 7B can be surely fixed to the engaging portions 15 and 17.

**[0017]** Furthermore, in the above-described constitution, the engaging portions 15 and 17 provided on the retainer member 9 have the apertures in the same direction. Therefore, it is possible to engage and detach the engaging portions 15 and 17 to and from the pair of rods 7A and 7B simultaneously. In this way, engagement and detachment can be facilitated.

**[0018]** As will be understood from the foregoing description, according to the present invention, the retainer member disposed between the spinous processes can be fixed integrally to the pair of rods disposed on the both sides of the spinous processes. Moreover, it is possible to allow the blades provided on the both sides in the width direction of the retainer member to bite into the spinous processes. Therefore, the distance between the spinous processes can be stably retained while controlling movements of the spinous processes, whereby the problem of the proposed art as described above will be satisfactorily resolved.

**[0019]** The entire content of a Japanese Patent Application No. P2002-32752 with a filing date of February 8, 2002 is herein incorporated by reference.

**[0020]** Although the invention has been described above by reference to certain embodiments of the invention, the invention is not limited to the embodiments described above will occur to these skilled in the art, in light of the teachings. The scope of the invention is defined with reference to the following claims.

## Claims

1. A vertebral body distance retainer, comprising:

   a retainer member including engaging portions to be engaged with a pair of rods provided on a plurality of adjacent vertebral bodies, and abutting portions capable of freely abutting on spinous processes of the adjacent vertebral bodies; and

   fixing screws which fix the rods, the rods being engaged with the engaging portions,

   wherein the vertebral body distance retainer is disposed between the spinous processes each existing on the adjacent vertebral bodies, so that the distance between the spinous processes can be retained constant.

2. The vertebral body distance retainer of claim 1, wherein the abutting portion is provided with a blade capable of biting into the spinous process.

3. The vertebral body distance retainer of claim 1, wherein the fixing screw is provided with a taper face at a tip portion thereof, the taper face being configured to abut on an outer peripheral face of the rod located in the engaging portion.

4. The vertebral body distance retainer of claim 1, wherein the fixing screw is located in a position being shifted from a central axis of the rod engaged with the engaging portion toward an aperture of the engaging portion.

FIG. 1A

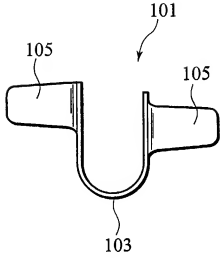



FIG. 1B

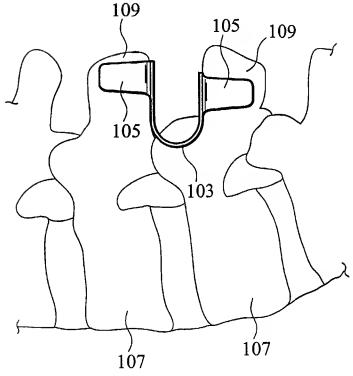


FIG. 2

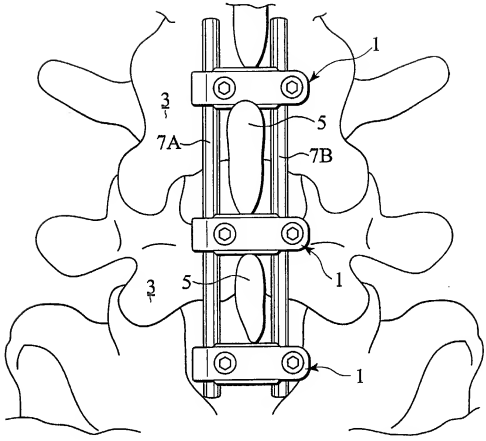


FIG. 3A

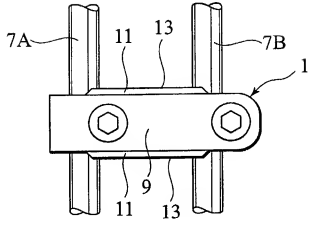
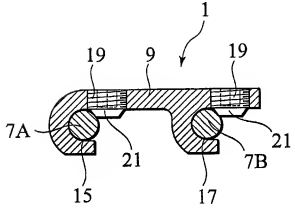



FIG. 3B



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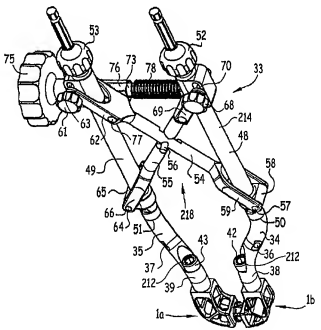
*[Continued on next page]*

(54) Title: CONNECTABLE INTERBODY IMPLANT




(57) Abstract: An intersomatic implant (1a, 1b) maintains bone graft material in a receiving cavity formed in a disc in order to obtain intervertebral fusion. The implant (1a, 1b) includes of a plurality of parts provided with means for in situ connection of two consecutive parts. Instruments (33) are used to connect these implants (1a, 1b) and a tool assists in introducing these implants (1a, 1b) into the cavity formed in the disc.

WO 03/071992 A2

SK, TR), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

**Published:**

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*For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.*

# CONNECTABLE INTERBODY IMPLANT

## BACKGROUND

The present invention generally concerns the field of interbody implants with which it is possible to obtain fusion of two adjacent vertebrae when the disc separating them has been damaged, and more specifically, but not exclusively, it concerns the implants commonly referred to as "interbody cages" or "intersomatic cages" which are intended to receive a bone graft and to maintain the latter in place during the fusion, after partial excision of the damaged disc.

When a disc separating two vertebrae has degenerated and interbody fusion is necessary, this can be obtained by implanting interbody cages in cavities formed in the degenerated disc. The interbody cages are often fitted by the anterior route, in which case it is possible only to provide a single cage of this type, implanted in the central region of the disc. However, when the lumbar region is involved, an approach by the posterior route is possible on account of the fact that the nervous system there is less dense than in the other regions of the spine. There is therefore less risk of damaging the nervous system there during the surgical intervention. Nevertheless, the presence of the medullary canal in practice requires the use of two small sized interbody implants that are symmetrically arranged relative to the axis of the spine. These bilateral implants are separate components that are not connected to one another. There is therefore a risk of relative displacement or expulsion of the implants, especially since an implant of small size is less stable, in particular rotationally less stable, than an implant of larger size.

## SUMMARY

One object of the present invention is to provide a unique interbody implant for spinal fusion and corresponding method to facilitate implantation of the implant.

In the case of intervertebral fusion by a posterior approach performed in the lumbar region, one object of the invention is to provide surgeons with the possibility of using interbody implants having a high degree of stability, while at the same time guaranteeing, as in current practice, a high level of safety during fitting of the implants.

To this end, the invention relates to an interbody implant for inserting and maintaining a bone graft in place in a receiving seat formed in a disc with a view to obtaining intervertebral fusion, characterized in that it consists of a plurality of parts provided with means for in situ connection of two consecutive parts.

According to a first variant of the invention, the interbody implant comprises a first part intended to be oriented in the posterior-anterior direction of the spine, and a second part oriented substantially perpendicular to the first part, the parts being connected by a transition portion, the front face of the second part of the implant comprising either a protrusion, making this implant a male implant, or a receiver for inserting and holding the protrusion, making this implant a female implant, in order to achieve and maintain a connection between such a male implant and such a female implant.

The male interbody implant can comprise, on the front face of its second part, a protrusion which successively comprises starting from the front face:

- a first substantially cylindrical portion having a given diameter "D1";
- a second substantially cylindrical portion having a diameter "D2" greater than "D1";
- and a substantially frustoconical portion whose initial diameter is equal to "D2" and decreases as the distance from the front face increases.

The female interbody implant can comprise, on the front face of its second part, a receiver delimited externally by elastic tongues which finish in a bulge.

The above-mentioned male interbody implant and female interbody implant may form a unit, the shape and the dimensions of the tongues of the female implant and of their bulges making them able to cooperate with the protrusion of the male implant in order to achieve and maintain a connection of the two implants.

The male interbody implant can comprise, on the front face of its second part, a protrusion whose general external shape is that of a cylinder portion whose cross section has

a circumference which extends over an angle greater than 180° in such a way as to define two receiving seats in the area of its zones of connection with the front face.

The female interbody implant can comprise, on the front face of its second part, two elastic tabs, which between them define a receiver.

The above-mentioned male interbody implant and female interbody implant may form a unit, the shape and the dimensions of the elastic tabs of the female implant making them able to permit insertion of the protrusion of the male implant into the receiver, the ends of the elastic tabs being inserted into the receiving seats in order to achieve and maintain a connection of the two implants.

The invention also relates to an instrument for in situ connection of a male interbody implant and a female interbody implant of the above types, characterized in that it comprises two rods which are each equipped with means for fixing to the front face of the first part of an implant, and means for moving the rods towards one another while holding them in parallel positions.

The means for moving the rods towards one another can comprise:

- two tubes in which the rods can be inserted and blocked;
- a first transverse rod connecting the front end of the first tube to the rear end of the second tube, and a second transverse rod connecting the front end of the second tube to the rear end of the first tube, the transverse rods intersecting in the area of an articulation permitting their rotation about a common hinge pin perpendicular to the plane including the tubes;
- means for articulating the first transverse rod about a hinge pin perpendicular to the plane including the tubes, situated towards the front end of the first tube and held fixed in translation, and means for articulating the first transverse rod about a hinge pin perpendicular to the plane including the tubes, situated towards the rear end of the second tube and movable in translation in a receiving seat extending along the second tube;
- means for articulating the second transverse rod about a hinge pin perpendicular to the plane including the tubes, situated towards the front end of the second tube and held fixed in translation, and means for articulating the second transverse rod about a hinge pin perpendicular to the plane including the tubes, situated towards the rear end of the first tube and movable in translation in a receiving seat extending along the first tube;
- and means for moving the tubes towards one another in a controlled manner.

The means for moving the tubes towards one another can comprise a receiver articulated in rotation about a hinge pin perpendicular to the plane including the tubes and

passing through the second transverse rod in proximity to the first tube, an externally threaded rod of which one end is inserted in the receiver and the other end is inserted in the internal space of a tube equipped with a thread corresponding to the thread of the rod, and means allowing the surgeon to turn the tube in order to regulate the depth of insertion of the rod in the tube, and a receiving seat traversed by the rod and articulated in rotation about a hinge pin perpendicular to the plane including the tubes and passing through the first transverse rod in proximity to the second tube.

The instrument can comprise a spring around the threaded rod, bearing on the receiver and the receiving seat.

According to a second variant of the invention, the interbody implant can comprise a central part and two lateral parts, which can be connected to the central part by connection means.

The connection means can comprise tapped holes formed in the end faces of the central part, and screws which can be inserted into the tapped holes and whose heads can come to rest on bearing surfaces formed on the lateral parts.

An instrument set for fitting an implant of the above type in place can comprise:

- a rod provided with means, at one of its ends, for fixing the central part of the implant;
- and two tools formed by a sheath provided at one of its ends with means permitting one of the lateral parts of the implant to be maintained there, and a screwdriver arranged inside the sheath and provided with an impression which can cooperate with the screw.

The instrument set preferably also comprises:

- a crosspiece with which it is possible to maintain the rod and the tool in determined respective angular positions during fitting of the first of the two lateral parts of the implant,
- a crosspiece with which it is possible to maintain the two tools in determined respective angular positions during fitting of the second of the lateral parts of the implant.

A tool to assist in introducing an interbody implant into a receiving seat formed in an intervertebral disc may comprise:

- a first part including a protector guide of which one end, intended to remain at the inlet of the receiving seat during the introduction, has a width "l" substantially equivalent to the height of the receiving seat and is equipped with stops intended to bear against the outer surfaces of the vertebrae;

- a second part including a distractor element placed at the end of a rod;
- a third part including a tubular element into which the rod of the second part can be inserted;
- and means permitting assembly of the three parts in a position permitting insertion of the end of the protector guide and the distractor element into the receiving seat, then disassembly of the three parts in such a way as to leave only the end of the protector guide in the receiving seat.

The means permitting assembly and disassembly of the three parts can include:

- protrusions formed on the sides of the end of the protector guide;
- receiving seats formed on the upper and lower faces of the distractor element in order to insert the protrusions of the protector guide therein;
- at least one stud formed on the anterior face of the tubular element and at least one corresponding notch formed on the posterior face of the distractor element;
- an orifice formed on the rod of the second part, a tapped hole formed on the tubular element of the third part, and a threaded element which can be inserted into the tapped hole and the orifice in such a way as to block the second and third parts relative to one another while at the same time blocking the protrusions of the protector guide in their receiving seats provided on the distractor element.

As will have been understood, the invention lies in providing a possibility of interconnection between two or more interbody implants while or after they are/have been placed separately in the degenerated disc (in other words in situ) in such a way as to form there a stable and integrated platform. Thus, in functional terms, a single implant is obtained which is made up of a plurality of segments connected to one another, without the disadvantages and risks, which would be involved in implanting a single monobloc implant by a posterior approach.

Further objects, embodiments, forms, aspects, features, benefits, and/or advantages will be apparent from the description and drawings provided herewith.

## BRIEF DESCRIPTION OF DRAWINGS

The present invention will be better understood on reading the following description in which reference is made to the attached figures:

- FIG. 1 shows, viewed in perspective, of two half-implants, male (FIG. 1A) and female (FIG. 1B), according to one embodiment of the present invention;
- FIG. 2 shows, in a plan view (FIG. 2A) and in a side cross-sectional view along 2B-2B, the two half-implants from FIG. 1 in the connected state;
- FIG. 3 shows, viewed in perspective, a second example of two half-implants, male (FIG. 3A) and female (FIG. 3B), according to the invention;
- FIG. 4 shows, viewed in perspective, the two half-implants from FIG. 3 in the connected state;
- FIG. 5 shows, viewed in perspective, an instrument designed for the positioning and connection of two half-implants according to the invention;
- FIG. 6 shows, in a plan view and longitudinal section, a variant of the instrument in FIG. 5; and
- FIG. 7 shows, in perspective, an instrument to assist in fitting a half-implant according to the invention, on the one hand in the assembled state (FIG. 7A) and on the other hand in the disassembled state (FIGS. 7B, 7C, 7D).
- FIG. 9 shows, in perspective, a rod which is used when fitting the implant in FIG. 8;
- FIG. 10 shows a tool which is also used during this fitting; and
- FIGS. 11 and 12 show, in perspective, two stages of this fitting.

## DESCRIPTION OF SELECTED EMBODIMENTS

For the purposes of promoting an understanding of the principles of the invention, reference will now be made to the embodiments illustrated in the drawings and specific language will be used to describe the same. It will nevertheless be understood that no limitation of the scope of the invention is thereby intended. Any alterations and further modifications in the illustrated device, and further applications of the principles of the invention as illustrated or described herein are contemplated as would normally occur to one skilled in the art to which the invention relates.

To implant the connectable interbody implants according to one embodiment of the invention by the posterior route, the surgeon begins, in a conventional manner, by partially resecting the articular facets of the two vertebrae concerned in the operation so as to gain access to the degenerated disc. The surgeon then performs a partial discectomy so as to create fusion beds corresponding to the external shape of each of the half-implants, and the surgeon prepares the vertebral plates so as to permit subsequent fusion of the vertebrae using bone grafts enclosed by the implants which are going to be fitted. The above-described discectomy and vertebral plate preparation techniques are widely known. U.S. Patent No. 6,174,311 issued on January 16, 2001 to Branch et al., for example, describes such techniques. In one embodiment of the present invention, the two cavities formed during the partial discectomy must communicate with one another in the anterior region of the disc, in such a way as to permit connection of the half-implants in the last stage of their fitting. In one form, this technique can be performed with tools such as those described in the published PCT patent application WO-A-0128469, which is hereby incorporated by reference. Preparing the vertebral plates and maintaining the desired intervertebral distance during fitting of the half-implants can be achieved with the aid of an instrument, which will be described below. After the preparation stage, the half-implants are inserted. Two examples of pairs of such half-implants will be described herein, it being understood that these examples are nonlimiting.

According to the first of these illustrative embodiments of the invention, the two half-implants represented in FIG. 1, namely a male half-implant 1a and a female half-implant 1b, each include an interbody cage 2 intended to enclose a bone graft or bone graft material. Each cage 2 comprises a first part 3 intended to be oriented in the posterior-anterior direction of the spine, and a second part 4 oriented substantially perpendicular to the first part 3, and being connected to the first part 3 via a transition portion 5. In one embodiment, the walls of

the cage 2 at the transition portion 5 have a curvilinear shape, that is to say without sharp corners which could damage the surrounding organs during and after fitting of the half-implants 1a, 1b. In the illustrated embodiment, the cage 2 has a set of first holes 6, 7 which pass right through it between its upper surface 202 and its lower surface 204, and a set of second holes 8, 9 which pass right through the cage 2 between its side surfaces 206 and 208. These holes 6, 7, 8, 9 make it possible to insert bone graft material into the cage 2, prior to the half-implants 1a, 1b being fitted. Once implanted, the bone graft material in the cage 2 will come into contact with the vertebral plates and the remaining part of the disc. Upon bone ingrowth into the cage 2, the bone graft material aids in fusing the vertebrae together. Front face or tool engagement face 10 of the first part 3 of each half-implant 1a, 1b has a hole 11 that allows the half-implant 1a, 1b to be connected to an implantation tool, such as the ones which will be described below with reference to FIGS. 5 and 6. The holes 11 in one form are threaded so as to engage with screws on the implantation tool. As depicted in the illustrated embodiment, each hole 11 has a pair of alignment notches 209 formed on opposite sides of the hole 11, which are used to orient the half-implants 1a, 1b with the implantation tool.

As shown, the two half-implants 1a, 1b in the first illustrated embodiment have second parts 4 with different front or connection faces 12, 17. The connection face 12 of the second part 4 of the male half-implant 1a includes a protrusion 13. The protrusion 13 comprises successively, starting from connection face 12:

- a first substantially cylindrical portion 14 having a given diameter "D1";
- a second substantially cylindrical portion 15 having a diameter "D2" that is greater than "D1";
- and a substantially frustoconical portion 16 whose initial diameter is equal to "D2" and decreases as the distance from connection face 12 increases.

The connection face 17 of the second part 4 of the female half-implant 1b includes a socket or receiver 18 for the protrusion 13 of the male half-implant 1a. The socket 18 is delimited externally by a series of elastic tongues 19. Each of the tongues 19 ends in a bulge 20 having a bevelled part 21 which cooperates with the frustoconical portion 16 upon engagement of the protrusion 13 in the socket 18, in such a way as to spread the tongues 19 apart. The tongues 19 return to their initial position after complete engagement of the protrusion 13 in the socket 18. The bulges 20 then cooperate with the connection face 12 of the male half-implant 1b and the cylindrical portions 14, 15 of the protrusion 13 so as to maintain engagement between the protrusion 13 and the socket 18. The two half-implants 1a,

1b are thus connected to form the functional equivalent of a single implant, such as is represented in FIG. 2, and they can only be disconnected by a deliberate action exerted upon their means of connection.

In the example shown, the half implants 1a, 1b, once connected together, have a horseshoe or U-shape. The height of each half implant 1a, 1b tapers or decreases progressively from second part 4 to the first part 3. In one embodiment, each half implant 1a, 1b tapers in a manners that generally matches the lordotic angle of the vertebrae. It is contemplated, however, that in other embodiments the upper 202 and lower 204 surfaces of the first part 3 can extend generally in a parallel relationship and/or can be substantially cylindrical in shape. The second parts 4 of the half implants 1a, 1b too can have various shapes, and the one shown in FIGS. 1 and 2 are only examples.

According to a second illustrated embodiment of the invention, two half-implants 22a, 22b represented in FIG. 3 are similar, in their general design, to those of the first embodiment shown in FIGS. 1 and 2. It should be noted that their common elements have been designated by the same reference numbers. As shown in FIG. 3A, the male half-implant 22a includes, on connection face 12 of its second part 4, a protrusion 23 which this time has an external shape that is generally cylindrical and, as is shown, defines a centrally located recess or cavity 210. In one form, bone graft material can be packed into cavity 210 in order to promote fusion. The cylindrical-shaped protrusion 23 has a cross section whose circumference extends over an angle that is at least greater than 180° so as to define two receiving seats or grooves 24, 25 proximal the connection face 12.

The female half-implant 22b includes, on the connection face 17 of its second part 4, two elastic tabs 26, 27 which between them define an internal space 28 forming a receiver or socket for accommodating the protrusion 23 of the male half-implant 22a and for holding it there. In one form, notches 29, 30 are defined in the tabs 26, 27 proximal the connection face 17 of the female-half implant 22b, which facilitate the spreading of the tabs 26, 27 when the protrusion 23 comes into contact with them. Ends 31, 32 of the tabs 26, 27 are shaped in such a way as to be inserted in the receiving seats 24, 25 of the zones of connection of the protrusion 23 with the connection face 12 of the male half-implant 22a when the protrusion 23 is entirely engaged in the internal space 28 defined by the tabs 26, 27. In this way the protrusion 23 is firmly held in this internal space 28 and can be dislodged therefrom only by a deliberate action exerted upon the half-implants 22a, 22b. FIG. 4 shows the two half-implants 22a, 22b in the assembled position forming the functional equivalent of a single implant. As should be appreciated, the half-implants 22a, 22b illustrated in FIG. 4 allow for

greater tolerance with respect to possible discrepancies in height between the two half-implants 22a, 22b when they are connected. A slight discrepancy in height between the two half-implants 22a, 22b does not compromise their connection or the maintenance of their connection.

Techniques and instrumentation for implanting the half-implants 1a, 1b, 22a and 22b will be described below with reference to FIGS. 5 and 6. Although the technique and instrumentation for inserting the half-implants 1a, 1b, 22a and 22b will be described below with reference to half-implants 1a and 2b, it should be understood that the below described techniques and instrumentation can be used with half-implants 22a and 22b as well as other types of half-implants. Before the half-implants 1a, 1b are inserted, the disc space is prepared in the manner as described above. The insertion of the of the half-implants 1a, 1b is then performed by attaching the half-implants 1a, 1b to the end of rods that are inserted in the holes 11 of the front faces 10 of their first parts 3, and by connecting the half-implants 1a, 1b together by manipulation of these rods. The ends of the second parts 4 of the half-implants 1a, 1b are then moved towards one another in order to connect them to one another in situ. Instrument 33 and 33' (implantation tool) allow for the connection of the half-implants 1a, 1b in such a manner . The instrument 33, 33' allows the half-implants 1a, 1b to be moved towards each other in a gradual and controlled manner while constantly keeping them in a parallel orientation. This improves the chance that the insertion of the protrusion 13, 23 of the male element 1a, 22a in the corresponding receiving seat 18, 28 of the female element 1b, 22b is effected under optimum conditions.

FIG. 5 illustrates one embodiment for the instrumentation 33 that is used to implant the half-implants 1a, 1b, and FIG. 6 illustrates instrumentation 33' according to another embodiment. It should be noted that instrumentation 33 and 33' share a number of common features. For the sake of brevity and clarity, instrumentation 33 and 33' will be discussed together below with particular reference to instrumentation 33. Although instrumentation 33 will be referenced below, it should be understood that the same description for instrumentation 33 applies as well as to instrumentation 33, with any notable distinctions between the two embodiments being highlighted. With reference to the embodiment illustrated in FIG. 5, the instrumentation 33 includes two rods 34, 35 composed of several parts that are connected together by systems which, for example, can include slots or holes and fixed or detachable indexing pins. In the FIG. 5 embodiment, the parts of the rods 34, 35 are connected together with detachable indexing pins 36, 37. It is contemplated, however, that the rods 34, 35 can each be made from a single part. For example, in the embodiment

illustrated in FIG. 6, the instrumentation 33' includes two rods 34', 35', each having a unitary construction.

The rods 34, 35 are intended to support the half-implants 1a, 1b, when the half implants 1a, 1b are connected together. However, the rods 34, 35 can also be used alone and independently by the surgeon for manipulating the half-implants 1a, 1b during insertion of the half-implants 1a, 1b in the receiving cavities (or seats) hollowed out in the degenerated disc. To fix the half-implants 1a, 1b in the illustrated embodiment, the rods 34, 35 each have a bent end part 38, 39 that defines an orifice 40, 41 in which a screw 42, 43 is received. In the embodiment illustrated in FIG. 5, these bent parts 38, 39 have a skewed shape in which the bent parts 38, 39 bend away from a plane defined by the rods 34, 35. By skewing bent parts 38 and 39 in such a manner, the area around the orifices 40, 41 is freed so that the screws 42, 43 can be easily accessed. However, it should be appreciated that the bent parts 38, 39 can have a planar arrangement. For instance, in the embodiment illustrated in FIG. 6, bent parts 38' and 39' are oriented in the same plane as the rest of the rods 34', 35'. At the extremity of the end part 38, 39, each rod 34, 35 has tabs 44, 45, 46, 47 intended to be inserted in receiving seats or alignment notches 209 formed on the sides of the holes 11 provided on the front faces 10 of the half-implants 1a, 1b, or in separate receiving seats specially designed for this purpose. These tabs 44, 45, 46, 47 make it possible to fix the half-implants 1a, 1b on the rods 34, 35 in defined orientations. The screws 42, 43, cooperating with the threads formed on the surfaces delimiting the holes 11 in the half-implants 1a, 1b, permit this fixation. The bent portions 38, 39 of the rods 34, 35 permit access to heads 212 of the screws 42, 43 so that these can be tightened and loosened. It goes without saying that the device for fixing the half-implants 1a, 1b which has just been described is but one example and that the skilled person can imagine other examples which would satisfy the same functions.

After the half-implants 1a, 1b have been secured to the rods 34, 35, the rods 34, 35 are introduced into a positioning device 214 that allows them to be held in a position in which the rods 34, 35 are oriented parallel with respect to one another. The positioning device 214 also makes it possible to regulate the spacing of the rods 34, 35 from each other so that the surgeon can bring the half-implants 1a, 1b towards each other and connect the half-implants 1a, 1b, after the half-implants 1a, 1b have been fitted in the receiving cavities hollowed out in the disc. In the example shown in FIGS. 5 and 6, the positioning device 214 in the first instance includes two tubes 48, 49 in which the rods 34, 35 are inserted. The rods 34, 35 are secured in the tubes 48, 49 by stop members or bearings 50, 51 (or any other

functionally equivalent device) formed on the rods 34, 35 on which the tubes 48, 49 come into abutment, and by internally threaded rings 52, 53 which, by cooperating with corresponding threads 216 formed on the ends of the rods 34, 35, press the stop members 50, 51 against the tubes 48, 49.

The tubes 48, 49 are connected to one another by means of an articulated device 218. The articulated device 218 in the first instance includes two transverse rods 54, 55, which are pivotally coupled to one another to permit their rotation about a common hinge pin 56, which extends perpendicular to the plane that includes the tubes 48, 49. The first transverse rod 54 is pivotally coupled to the distal or front end of the first tube 48 (that is to say the end nearest the half-implant 1a) about a hinge pin 57 that extends parallel to the common hinge pin 56 of the transverse rods 54, 55. Hinge pin 57 is held in a receiving seat 58 which is fixed to the first tube 48 and which prohibits any movement thereof in translation relative to the first tube 48. The pivoting of the first transverse rod 54 about the hinge pin 57 is ensured by a stirrup 59. As shown, the stirrup 54 of the first transverse rod 54 extends around opposite sides of tube 48. The first transverse rod 54 is also coupled to the proximal or rear end of the second tube 49 (that is to say the end farthest from the half-implant 1b) about a hinge pin 60. A knurled wheel 61 is threadedly coupled to hinge pin 60. Hinge pin 60 extends in parallel relationship with respect to the common hinge pin 56 of the transverse rods 54, 55. Hinge pin 60 is coupled with the first transverse rod 54 by a stirrup 62, which can pivot about hinge pin 60. Hinge pin 60 is able translationally move in a receiving seat or slot 63 that extends along the second tube 49. The second transverse rod 55 is similarly pivotally coupled to the front end of the second tube 49 about a hinge pin 64. Hinge pin 64 is held in a receiving seat 65 fixed to the second tube 49. As shown, rod 55 has a stirrup 66 that is received around tube 49, and the stirrup 66 is coupled to hinge pin 64. The second transverse rod 55 is also pivotally coupled to the rear end of the first tube 48 with a hinge pin 67. A knurled wheel 68 is threadedly coupled to the hinge pin 67. Hinge pin 67 is coupled to the second transverse rod 55 by a stirrup 69, which can pivot about hinge pin 67. Hinge pin 67 is able to translationally move in a receiving seat or slot 70 that extends along the first tube 48. The use of knurled wheels 61, 68 and the threaded hinge pins 60, 67 cooperating with corresponding threads formed in the stirrups 62, 69 ensures simple assembly and disassembly of the device 214.

Device 214 includes a receiver 71 that rotates about a hinge pin 72 that extends parallel to the other axes of rotation for hinge pins 56, 57, 60, 64 and 67, which were mentioned above. Hinge pin 72 passes through the second transverse rod 55 in proximity to

the first tube 48. One end of an externally threaded rod 73 is inserted and fixed in receiver 71. The other end of the threaded rod 73 is inserted in the internal space of a tube 74 equipped with a thread corresponding to the thread of the rod 73. Tube 74 is equipped with a knurled wheel 75 that allows the surgeon to turn it and thereby regulate the position of the rod 73 relative to the tube 74. As shown, a receiving seat 76 is rotatably coupled a hinge pin 77 that passes through the first transverse rod 54 in proximity to the second tube 49. Receiving seat 76 is able to rotate about an axis that is extends parallel to the axes of rotation of hinge pins 56, 57, 60, 54, 67 and 72, which were mentioned above. The threaded rod 73 passes through receiving seat 76.

After the whole instrument 214 has been assembled, the surgeon is able to move the two rods 34, 35 supporting the half-implants 1a, 1b towards or away from each other by turning the knurled wheel 75 in such a way as to regulate the penetration depth of the rod 73 in the tube 74, which determines the spacing of the rods 34, 35. Also, the ability of the transverse rods 54, 55 to rotate about the various hinge pins 56, 57, 60, 64, 67, 72, 77, and the ability of translational movement of hinge pins 60 and 67 in receiving slots 63 and 70, mean that this movement of the rods 34, 35 towards or away from each other is effected while ensuring permanent parallel positioning of the rods 34, 35. The half-implants 1a, 1b can therefore be moved towards each other in the direction most favourable to their proper connection.

A spring 78 is provided about the threaded rod 73 and bears on receiver 71 and receiving seat 76. The spring 78 makes it possible to increase the rigidity of the assembled instrument because the spring 78 tends to space the rods 34, 35 apart from one another in order to reduce the play which may exist between the different components controlling the spacing of the rods 34, 35. Reduction of this play can make use of the instrument 214 easier.

One should appreciate that variations can be made to the design of the positioning device 214 for controlling the movement of the two rods 34, 35. For example, it would be conceivable to move the rods 34, 35 together using an elastic device which can be controlled by a clamp or by simple manual pressure. The threaded-tube and threaded-rod device which has been described has the advantage of allowing easily controlled progressive clamping of the rods 34, 35, and permanent holding of a selected relative position of the rods 34, 35, permitting, if necessary, the half-implants 1a, 1b to move towards each other in several stages without requiring the surgeon to manually holds the rods 34, 35 in order to keep the spacing of the rods 34, 35 constant.

Once the half-implants 1a, 1b have been connected to one another, the rings 52, 53 are removed so as to allow disconnection of the rods 34, 35 from the rest of the positioning device 214. The screws 42, 43 are then loosened so as to disconnect the rods 34, 35 from the half-implants 1a, 1b whose implantation is then complete.

According to another variation of the present invention, the interbody implant no longer comprises two parts, but three parts, namely a central part and two lateral parts which are fixed together more or less rigidly depending on the wishes of the user. An illustrative embodiment of this variation is shown in FIGS. 8A and 8B. In implant assembly 224, a central part 106 of the implant 224 is in the form of a cage, which has apertures 107 through its upper and lower faces and apertures 108 through its lateral faces, in such a way as to permit a bone graft material to be inserted into the central part 106 prior to its fitting. The central part 106 has a general shape that is slightly arched in order to match the shape of the receiving cavity that has been formed in the disc. The ends of the central part 106 include end faces 109, 110 oriented obliquely in relation to the general direction of the central part 106, so as to be easily accessible from the outside when the central part 106 is in place in its receiving cavity. The implant 224 also includes two lateral parts 111, 112 in the form of cages, which have apertures 113, 114, 115 and 116 for receiving bone graft material. The lateral parts 111, 112 are connected to the central part 106 by way of screws 117, 118, which can be inserted into tapped holes 119 formed in the end faces 109, 110 of the central part 106, and the heads of which engage bearing surfaces 120 formed on the lateral parts 111, 112. This assembling of implant 224 by means of screws 117, 118 gives it great rigidity.

To fit implant 224 in place, the following described techniques can be used. The central part 106 is fixed with the aid of a screw 121 (which, as is shown, can be identical to one of the screws 117, 118 which will be used for assembling the implant 224) to the end of a rod 122 which is designed, for example, in a manner similar to one of the rods 34, 35 of the instrument set shown in FIGS. 5 and 6, as can be seen from FIG. 9. The surgeon then introduces the central part 106 into the receiving cavity that was formed beforehand in the damaged disc. Of course, it should be appreciated that other means of fixing other than the screw 121 are conceivable.

In the following stage, the surgeon uses a tool 123, shown in FIG. 10, which is made up of two main parts:

- a sheath 124 provided at one of its ends with means permitting one of the lateral parts 111, 112 of the implant to be maintained there, for example comprising two studs or

tabs 125 which cooperate with two corresponding notches 126, 127 formed on the anterior face 128 of each of the lateral parts 111, 112; and

- a screwdriver 129 extending inside and through the sheath 124; one of its ends is provided with an impression or head 130 which can engage with the screw 117, and the other end is provided with a grip handle 131 that allows the surgeon to turn the screwdriver 129.

In the example shown, a tube 132 is positioned inside the sheath 124 such that there is only a slight clearance between the tube 132 and the sheath 124 so that the tube 132 is able to move inside the sheath 124. As depicted in FIG. 10, the tube 132 in the sheath 124 has externally threaded end 226, and the tube 132 can be rotated through a knurled wheel 132', which is attached to the tube 132. When rotated, the threaded end 226 of the tube 132 is used to engage with a corresponding threading formed in a bore 137 of the anterior face 128 of a lateral part 111, 112 of the implant 224. One could of course conceive of other means for maintaining the lateral part 111, 112 of the implant 224 connected to the sheath 124. As shown, the screwdriver 129 is slidably received inside tube 132 such that the screwdriver 129 is able to rotate inside tube 132 and tighten screw 117.

Referring to FIG. 11, lateral part 111 of the implant 224 is secured to the threaded end 226 of the tube 132 in tool 123, and the screw 117 is placed at the end of the screwdriver 129 of the tool 123. Lateral part 111 of the implant 224 is then inserted into the receiving cavity formed in the disc in order to move it to the central part 106, which is still fixed to the rod 122. Lateral part 111 is positioned to bring the screw 117 in alignment with the tapped hole 119 formed in the face 109 of the central part 106. To facilitate this positioning, in one embodiment, a calibrated crosspiece 133 is used to maintain the rod 122 and the tool 123 in a suitable angular orientation. The crosspiece 133 also makes it possible to obtain a precise placement of the central part 106 of the implant in its receiving cavity. When the desired positioning is obtained, the surgeon turns the screwdriver 129 in order to tighten the screw 117 so as to secure the central part 106 and the lateral part 111. FIG. 11 illustrates the configuration of the implant assembly 224 at the end of this stage (the disc and its surrounding area have not been shown for the sake of clarity).

After the lateral part 117 is attached to the central part 106, the rod 122 is then disconnected from the central part 106 of the implant 224 by loosening the screw 121. The other lateral part 112 of the implant 224 is attached at the threaded end 226 of a tool 123', which is identical to the previous tool 123. Screw 118 is placed at the end of the screwdriver 129' in the tool 123'. With tool 123', lateral part 112 is moved to engage the end face 110 of the central part 106 that was disengaged from rod 122. The other lateral part 112 is then

secured to the central part 106 with screw 118 in the same manner as described above. In one embodiment, a crosspiece 134 is used to maintain the angular positioning of the two tools 123, 123'. FIG. 12 shows the assembly 224 at the end of this stage. Once the other lateral part 112 has been fixed, the two tools 123, 123' are withdrawn by rotation of the knurled wheels 132' making it possible to detach the tubes 132 from the bores 137 of the anterior faces 128 of the lateral parts 111, 112.

When the two tools 123, 123' are removed, the insertion of the implant 224 is thus completed. In one embodiment, to make it easier to align the screws 117, 118 with the tapped holes 119 of the central part 106, a metal wire is passed through a central aperture 135 (FIG. 8B) in the screw 121 that connects rod 122 to the end face 109 of the central part 106. The wire is further passed through the tapped hole 119 of the other end face 110 of the central part 106. The screws 117, 118 and the screwdrivers 129, 129' are themselves provided with central apertures 135, 136, 136' in which the wire can be passed through. With the wire passing through the screws 117, 118 and the screwdrivers 129, 129', the end of the portion of the wire extends from tapped hole 119 so that the screws 117, 118 are correctly guided towards the tapped holes 119. After the rod 122 has been withdrawn, the other end of the wire emerging from the central part 106 becomes accessible, and the screw 118 carried by the screwdriver 129' of the tool 123' can be engaged on this end of the wire. After the implant 224 has been fitted, the wire is removed.

The above-described embodiment in which the implant includes three parts has at least the following advantages:

- at each operation, only a component of relatively small dimensions is inserted into the body of the patient; this entails a less invasive approach; it is no longer necessary to remove as many stabilizing elements like the articular facets of the vertebrae, and it is possible to dispense with sectioning the muscles, and instead they need only be moved aside: recovery is therefore quicker; and
- the connection operations take place closer to the openings of the cavity formed in the disc, thus in a zone which is visible to the surgeon, making it easier to fit the implant; moreover, this permits a connection by screws, thus one which is rigid, reliable and relatively easy to effect.

The connection means which have been described and shown for this illustrative embodiment of the invention are not exclusive, and the person skilled in the art will be able to adopt other connection means analogous, for example, to those described for the previously described implant variants made up of two parts. The degree of rigidity sought for

the assembled implant will be a criterion in choosing the method of connecting the different parts. The person skilled in the art will be readily able to adapt the configurations of the different parts of the implant to this effect, and of the tools used to fit them, by drawing inspiration from what has been set out in this description.

When the implants (1a, 1b), (22a, 22b), (106, 111, 112) are being put in place, it is possible for the surgeon to use spacer tool 78, which aids in introducing the parts of the implants (1a, 1b), (22a, 22b), (106, 111, 112) into their respective receiving cavities. Tool 78 maintains the space between the vertebrae concerned, while at the same time protects the surrounding area, in particular the spinal nerves, which is very important in the posterior lumbar region where the implants (1a, 1b), (22a, 22b), (106, 111, 112), according to one embodiment, are intended to be implanted.

This tool 78 is made up of three parts. The first part is a protector guide 79 of which one end 80 is intended to be positioned at the inlet of one of the receiving cavities formed in the vertebrae for the half-implants (1a, 1b), (22a, 22b), (106, 111, 112) during their introduction. The rest of tool 78 is designed to protect the surrounding area of the work zone and to permit easy manipulation by the surgeon, for example, as is shown, in the form of a straight part finishing in a bent part 82 set outwards from the operating site. As shown in FIG. 7B, end 80 of tool 78 has a width "l" largely equivalent to the height of the receiving cavities formed in the disc for fitting of the implants (1a, 1b), (22a, 22b), (106, 111, 112). It is equipped with stops 81, 82 that are configured to bear against the outer surfaces of the vertebrae upon introduction of the instrument into the receiving cavity, so as to limit its penetration to the necessary length. End 80 of the protector guide 79 is also equipped on its sides with two protrusions 83, 84 that have a generally triangular shape and are equipped with posterior notches 85, 86 whose function will be explained below.

The second part of tool 78 is a distractor element 87, which is configured to support the end 80 of the protector guide 79 upon its insertion into the receiving cavity formed in the vertebrae for the implant (1a, 1b), (22a, 22b), (106, 111, 112). The distractor element 87 is tapered at its front end 88 to facilitate its introduction into the receiving cavity formed in the vertebrae. The distractor element 87 is placed at the end of a rod 89 which has, on its cylindrical lateral wall, an orifice 90 whose function will be explained below. Engagement seats are formed in the upper face 91 and lower face 220 of the distractor element 87 for the protrusions 83, 84 of the protector guide 79. These engagement seats are each delimited on the one hand by a stud 92 which is received in one of the posterior notches 85, 86 in the protrusions 83, 84 of the and on the other hand by a hollowed-out portion 93 which receives

the free corner 94, 95 of one of the protrusions 83, 84 by blocking its movements towards the front of the distractor element 87. The distractor element 87 also has, on its rear face, two notches 96 whose function will be explained below.

The third part of tool 78 is a tubular element 97, with rectangular cross-section in the example shown, and provided with a receiving cavity 98 permitting insertion of the rod 89 of the second part of the tool 78. One of the lateral surfaces 222 of the tubular element 97 has a tapped hole 99 in which a threaded element 100 with a knurled wheel 101 is threaded. End 102 of the threaded element is configured to penetrate into the orifice 90 of the rod 89 of the distractor element 87 when tool 78 is assembled. The position of the tapped hole 99 is determined accordingly. Anterior face 103 of the tubular element 97 has studs 104, 105 that are configured to be inserted in the notches 94 of the posterior face of the distractor element 87. The studs 104, 105 and the notches 94 make it possible to regulate the relative positions of the distractor element 87 and the tubular element 97 in such a way that orifice 90 in the distractor element 87 and the tapped hole 99 in the tubular element 97 are automatically aligned with one another upon assembly of the tool 78. It would of course be possible to provide just one stud 102, 103 and a single notch 94 or any other means of establishing suitable relative positions of the distractor element 87 and the tubular element 97 when assembling the tool 78.

Tool 78 is assembled as follows. In a first stage, the protector guide 79 and the distractor element 87 are placed one on top of the other, with the triangular protrusions 83, 84 of the protector guide 79 inserted in the corresponding receiving seats of the distractor element 87. In a second stage, the rod 89 of the distractor element 87 is inserted in the receiving cavity 98 of the tubular element 97 and secured inside the receiving cavity 98 with the threaded element 100, which is made to penetrate into orifice 90. The triangular protrusions 83, 84 are thus secured in their respective receiving seats on the distractor element 87 by the anterior face 103 of the tubular element 97, and the whole tool is thus stabilized, with the protector guide 79 held along the tubular element 97. The distractor element 87 and the end 80 of the protector guide 79 are then inserted in a receiving cavity previously hollowed out in the degenerated disc, in such a way as to establish the exact interdiscal distance necessary for introducing the corresponding implant (1a, 1b), (22a, 22b), (106, 111, 112), which distance is substantially equal to "l", and to complete the preparation of the receiving seat surfaces. The threaded element 100 is then loosened, which allows the third part of the tool to be withdrawn, then the second part, so that only the end 80 of the protector guide 79 is left remaining in the receiving cavity. A part of implant (1a, 1b), (22a,

22b), (106, 111, 112) is then inserted in the receiving cavity. With the end 80, it is possible to maintain the desired interdiscal space during this introduction, while the rest of the protector guide 79, which extends outside the receiving cavity for the implant (1a, 1b), (22a, 22b), (106, 111, 112), makes it possible to move aside and protect the organs of the patient which are situated on the path of insertion of the implant (1a, 1b), (22a, 22b), (106, 111, 112).

It goes without saying that detailed modifications can be made to the various parts of the tool 78 (in particular as regards the means of joining its various parts), provided that the essential functions of its various elements are retained. This tool can also be used to assist in placing interbody implants having a configuration different than that of the implants (1a, 1b), (22a, 22b), (106, 111, 112) described herein.

While the invention has been illustrated and described in detail in the drawings and foregoing description, the same is to be considered as illustrative and not restrictive in character, it being understood that only the preferred embodiment has been shown and described and that all changes, modifications, and equivalents that come within the spirit of the inventions described herein and/or defined by the following claims are desired to be protected.

What is claimed is:

1. Intersomatic implant for inserting and maintaining a bone graft in place in a receiving seat formed in a disc with a view to obtaining intervertebral fusion, characterized in that it consists of a plurality of parts provided with means for in situ connection of two consecutive parts.

2. Intersomatic implant according to Claim 1, characterized in that it comprises a first part intended to be oriented in the posterior-anterior direction of the spine, and a second part oriented substantially perpendicular to the first part, said parts being connected by a transition portion, the front face of the second part of said implant comprising either a protrusion, making this implant a male implant, or a receiver for inserting and holding said protrusion, making this implant a female implant, in order to achieve and maintain a connection between such a male implant and such a female implant.

3. Male intersomatic implant according to Claim 2, characterized in that it comprises, on the front face of its second part, a protrusion which successively comprises starting from said front face:

- a first substantially cylindrical portion having a given diameter "D1";
- a second substantially cylindrical portion having a diameter "D2" greater than "D1";
- and a substantially frustoconical portion whose initial diameter is equal to "D2" and decreases as the distance from the front face increases.

4. Female intersomatic implant according to Claim 2, characterized in that it comprises, on the front face of its second part, a receiver delimited externally by elastic tongues which finish in a bulge.

5. Unit formed by a male intersomatic implant according to Claim 3 and by a female intersomatic implant according to Claim 4, the shape and the dimensions of the tongues of the female implant and of their bulges making them able to cooperate with the protrusion of the male implant in order to achieve and maintain a connection of the two implants.

6. Male intersomatic implant according to Claim 2, characterized in that it comprises, on the front face of its second part, a protrusion whose general external shape is that of a cylinder portion whose cross section has a circumference which extends over an angle greater than 180° in such a way as to define two receiving seats in the area of its zones of connection with the front face.

7. Female intersomatic implant according to Claim 2, characterized in that it comprises, on the front face of its second part, two elastic tabs which between them define a receiver.

8. Unit formed by a male intersomatic implant according to Claim 6 and by a female intersomatic implant according to Claim 7, the shape and the dimensions of the elastic tabs of the female implant making them able to permit insertion of the protrusion of the male implant into the receiver, the ends of said elastic tabs being inserted into the receiving seats in order to achieve and maintain a connection of the two implants.

9. Instrument for in situ connection of a male intersomatic implant and a female intersomatic implant according to Claim 2, characterized in that it comprises two rods which are each equipped with means for fixing to the front face of the first part of an implant, and means for moving said rods towards one another while holding them in parallel positions.

10. Instrument according to Claim 9, characterized in that said means for moving said rods towards one another comprise:

- two tubes in which said rods can be inserted and blocked;
- a first transverse rod connecting the front end of the first tube to the rear end of the second tube, and a second transverse rod connecting the front end of the second tube to the rear end of the first tube, said transverse rods intersecting in the area of an articulation permitting their rotation about a common hinge pin perpendicular to the plane including the tubes;
- means for articulating the first transverse rod about a hinge pin perpendicular to the plane including the tubes, situated towards the front end of the first tube and held fixed in translation, and means for articulating the first transverse rod about a hinge pin perpendicular to the plane including the tubes, situated towards the rear end of the second tube and movable in translation in a receiving seat extending along the second tube;

- means for articulating the second transverse rod about a hinge pin perpendicular to the plane including the tubes, situated towards the front end of the second tube and held fixed in translation, and means for articulating the second transverse rod about a hinge pin perpendicular to the plane including the tubes, situated towards the rear end of the first tube and movable in translation in a receiving seat extending along the first tube;
- and means for moving said tubes towards one another in a controlled manner.

11. Instrument according to Claim 10, characterized in that said means for moving said tubes towards one another comprise a receiver articulated in rotation about a hinge pin perpendicular to the plane including the tubes and passing through the second transverse rod in proximity to the first tube, an externally threaded rod of which one end is inserted in said receiver and the other end is inserted in the internal space of a tube equipped with a thread corresponding to the thread of the rod, and means allowing the surgeon to turn said tube in order to regulate the depth of insertion of the rod in the tube, and a receiving seat traversed by the rod and articulated in rotation about a hinge pin perpendicular to the plane including the tubes and passing through the first transverse rod in proximity to the second tube.

12. Instrument according to Claim 11, characterized in that it comprises a spring around the threaded rod, bearing on the receiver and the receiving seat.

13. Intersomatic implant according to Claim 1, characterized in that it comprises a central part and two lateral parts which can be connected to the central part by connection means.

14. Intersomatic implant according to Claim 13, characterized in that said connection means comprise tapped holes formed in the end faces of the central part, and screws which can be inserted into said tapped holes and whose heads can come to rest on bearing surfaces formed on the lateral parts.

15. Instrument set for fitting an implant according to Claim 14, characterized in that it comprises:

- a rod provided with means, at one of its ends, for fixing said central part of the implant;

- and two tools formed by a sheath provided at one of its ends with means permitting one of the lateral parts of the implant to be maintained there, and a screwdriver arranged inside the sheath and provided with an impression which can cooperate with the screw.

16. Instrument set according to Claim 15, characterized in that it also comprises a crosspiece with which it is possible to maintain the rod and the tool in determined respective angular positions during fitting of the first of the two lateral parts of the implant.

17. Instrument set according to Claim 15 or 16, characterized in that it also comprises a crosspiece with which it is possible to maintain the two tools in determined respective angular positions during fitting of the second of the lateral parts of the implant.

18. Tool to assist in introducing an intersomatic implant into a receiving seat formed in an intervertebral disc, characterized in that it comprises:

- a first part including a protector guide of which one end, intended to remain at the inlet of said receiving seat during said introduction, has a width "l" substantially equivalent to the height of said receiving seat and is equipped with stops intended to bear against the outer surfaces of the vertebrae;
- a second part including a distractor element placed at the end of a rod;
- a third part including a tubular element into which the rod of the second part can be inserted;
- and means permitting assembly of said three parts in a position permitting insertion of the end of the protector guide and the distractor element into said receiving seat, then disassembly of the three parts in such a way as to leave only said end of the protector guide in said receiving seat.

19. Tool according to Claim 18, characterized in that said means permitting assembly and disassembly of the three parts include:

- protrusions formed on the sides of the end of the protector guide;
- receiving seats formed on the upper and lower faces of the distractor element in order to insert said protrusions of the protector guide therein;
- at least one stud formed on the anterior face of the tubular element and at least one corresponding notch formed on the posterior face of the distractor element;

- an orifice formed on the rod of the second part, a tapped hole formed on the tubular element of the third part, and a threaded element which can be inserted into said tapped hole and said orifice in such a way as to block said second and third parts relative to one another while at the same time blocking said protrusions of the protector guide in their receiving seats provided on the distractor element.

20. An interbody implant for implanting between adjacent vertebrae, comprising:

a male implant having engagement protrusion extending therefrom;

a female implant defining a socket; and

wherein said protrusion of said male implant is engaged in said socket of said female protrusion.

21. The implant of claim 20, wherein said socket is defined by a plurality of elastic tongues.

22. The implant of claim 20, wherein said protrusion has a cylindrical shape and said socket has a cylindrical shape.

23. An interbody implant, comprising:

a central cage having apertures for receiving bone graft material, said central cage having a pair of obliquely angled end faces; and

a pair of lateral cages engaged with said pair of obliquely angled end faces, said lateral cages having apertures for receiving bone graft material.

24. A method, comprising:

providing a male implant with an engagement protrusion and a female implant with a socket;

inserting the male implant and the female into a disc space defined between adjacent vertebrae; and

engaging the protrusion of the male implant with the socket of the female implant while in the disc space.

25. A method, comprising:

providing a central cage with a pair of obliquely angled end faces and a pair of lateral cages;

inserting the central cage in to a disc space defined between adjacent vertebrae; and

coupling the lateral cages to the obliquely angled end faces of the central cage while in the disc space.

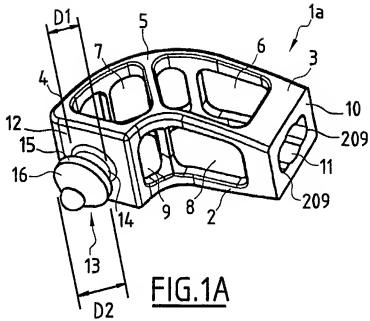


FIG.1A

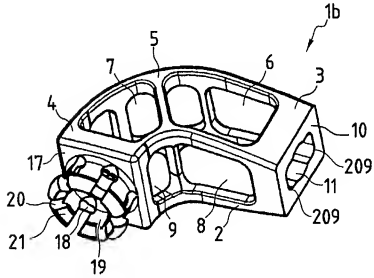


FIG.1B

FIG.1

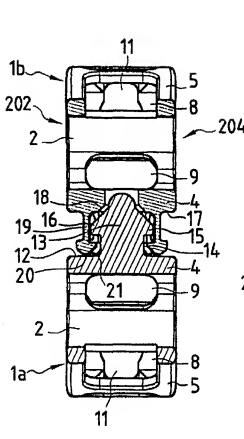


FIG.2A

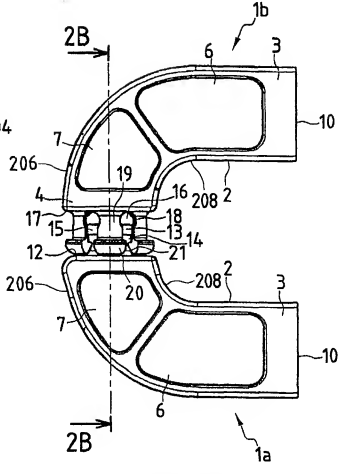


FIG.2B

FIG.2

FIG.3

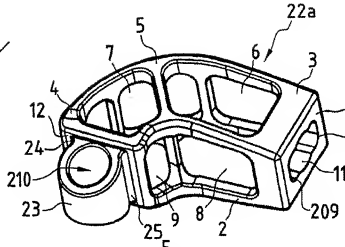


FIG.3A

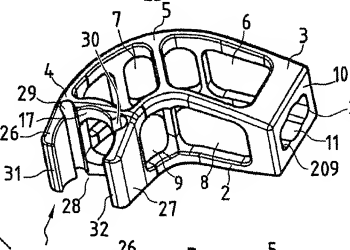


FIG.3B

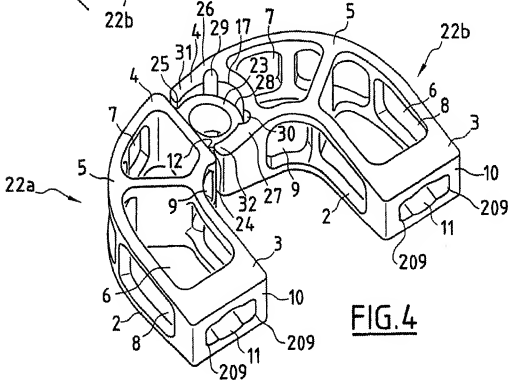


FIG.4

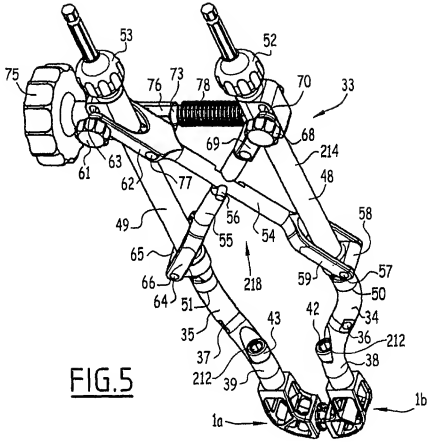
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FIG.5

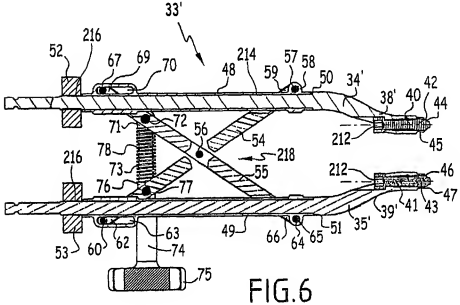
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FIG.6

FIG.7

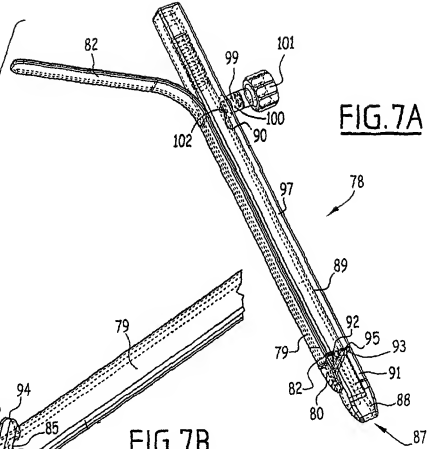


FIG.7A

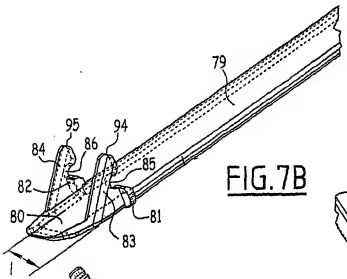


FIG.7B

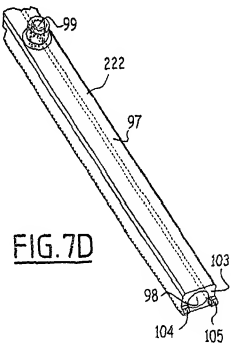


FIG.7D

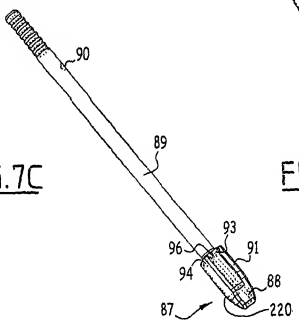


FIG.7C

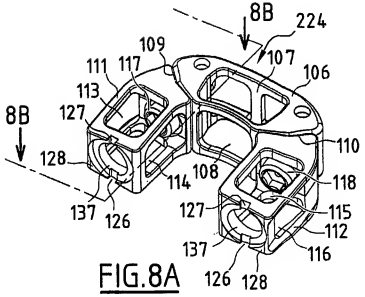


FIG.8A

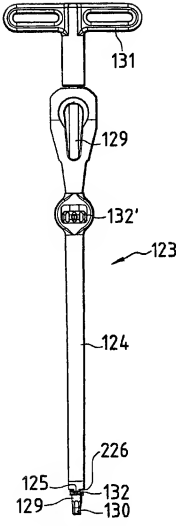


FIG.10

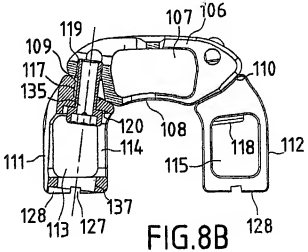


FIG.8B

FIG.8

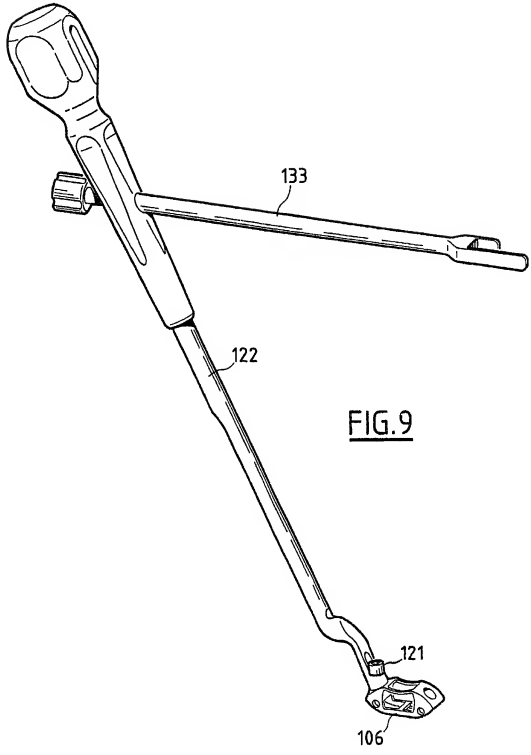


FIG.9

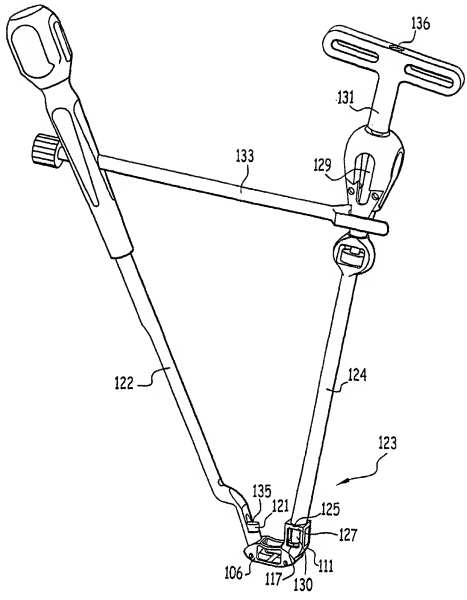


FIG.11

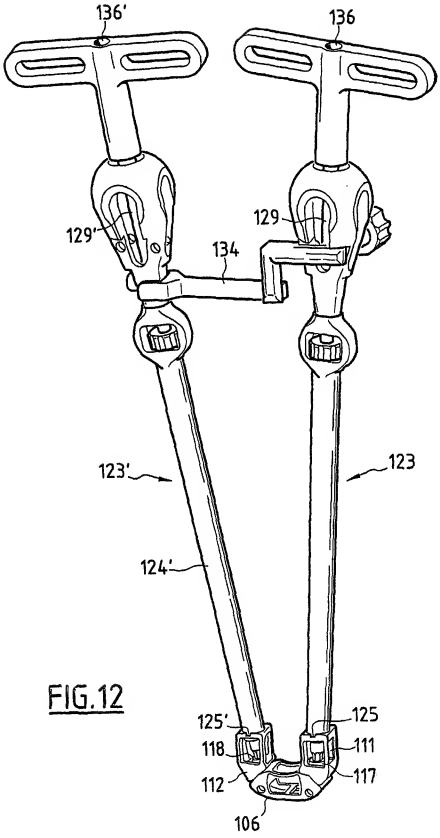


FIG.12